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CLIMATE CHANGE ADAPTATION AND COASTAL PROPERTY RIGHTS: A MASSACHUSETTS CASE STUDY

LARA D. GUERCIO*

Abstract: This Article examines how existing state laws, including coastal property law and public trust doctrines, are likely to create challenges for the implementation of adaptation strategies proposed to address the effects of climate change—specifically, accelerated sea level rise, increased coastal flooding and storm-related erosion—on coastlines and connected natural resource areas, such as beaches, coastal wetlands, and tidelands. The Article uses Massachusetts, with its highly evolved body of coastal property law and public trust doctrine, as a case study. Mindful of U.S. Supreme Court takings doctrine, the Article analyzes the likely legal challenges to climate change adaptation strategies recently proposed for Massachusetts’s coastal zone, and concludes with some preliminary suggestions to balance private property rights with the emerging public policy imperative for climate change adaptation.

INTRODUCTION

The intersection of climate change, its effects—including accelerated sea level rise (“SLR”) on coastal areas and shorelines—and the Supreme Court’s takings jurisprudence likely will throw into heightened relief traditional state-based littoral property rights. These rights include common law property interests associated with accretion, reliction, and avulsion.¹ U.S. coastal property law is further complicated by deeply-rooted, state-specific public trust doctrines, which in their broadest terms reserve public rights of use and access along traditionally defined

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¹ See *infra* notes 7–10, 357–370 and accompanying text.

coastlines.² Both common law rights and state statutes incorporating these legal principles, however, were judicially crafted and legislatively enacted at a time when the existence and effects of climate change on coastal development could not have been anticipated.³

To date, neither Massachusetts statutes nor case law have specifically addressed if the Commonwealth's public trust doctrine will migrate landward when SLR accelerates over historic baselines.⁴ Massachusetts's public trust doctrine provides use-specific public access for fishing, fowling, and navigation on and over "Private Tidelands" located above the historic low water mark.⁵ Scientists anticipate sea levels will rise due to the effects of climate change—scientifically documented to be caused primarily by anthropogenic activities, namely human use of fossil fuels.⁶ It is also unclear what legal significance shifts in coastlines, as accelerated by effects of climate change, will have on the location of existing property boundaries. Further, the question remains whether existing legal doctrines of accretion⁷ and reliction,⁸ or avulsion⁹ should apply to SLR.¹⁰

² See *Phillips Petroleum Co. v. Mississippi*, 484 U.S. 469, 473–74 (1988) (quoting *Shively v. Bowlby*, 152 U.S. 1, 57 (1894)).

³ See *id.* (explaining that the public trust doctrine derives from English common law); INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2007: SYNTHESIS REPORT, SUMMARY FOR POLICYMAKERS 2 (2007), available at http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf (explaining that climate change is a recent phenomenon).

⁴ See JAMES G. TITUS, CLIMATE READY ESTUARIES, ROLLING EASEMENTS 47 (2001); Heather J. Wilson, Comment, *The Public Trust Doctrine in Massachusetts Land Law*, 11 B.C. ENVTL. AFF. L. REV. 839, 853–59 (1984) (discussing application of Massachusetts public trust doctrine to the coastline without considering SLR).

⁵ 310 MASS. CODE REGS. 9.02 (2012).

⁶ INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *supra* note 3, at 5–6; U.S. CLIMATE CHANGE SCI. PROGRAM, COASTAL SENSITIVITY TO SEA LEVEL RISE: A FOCUS ON THE MID-ATLANTIC REGION 41–42 (2009).

⁷ Accretion is "the increase of land by the action of natural forces" and applies to the gradual and imperceptible enlargement of riparian or littoral lands by coastal processes such as currents and tides. See MERRIAM-WEBSTER'S COLLEGIATE DICTIONARY 8 (10th ed. 2001).

⁸ Reliction is "the gradual recession of water leaving land permanently uncovered" and applies to erosion of these same lands. See *id.* at 885.

⁹ Avulsion is "a sudden cutting off of land by flood, currents, or change in course of a body of water," which includes events that cause sudden and perceptible change in land. See *id.* at 80.

¹⁰ See Joseph L. Sax, *The Accretion/Avulsion Puzzle: Its Past Revealed, Its Future Proposed*, 23 TUL. ENVTL. L.J. 305, 306 & n.2 (2010) (describing the tensions between accretion and avulsion in property law). Further, the Massachusetts Supreme Judicial Court (SJC) has only historically applied the doctrine of avulsion to determine the location of riparian property rights and boundaries, but not to date in the context of littoral coastal property rights. See *infra* notes 382–384 and accompanying text.

Even in the absence of observed and widely predicted climate change, Massachusetts's varied fifteen thousand-mile coastline exists as a dynamic equilibrium between land and sea—shaped by the natural forces of wind and waves and human land uses, activities, and development.¹¹ Coastlines naturally shift and adjust to relative shoreline shape, availability of sediment, increases in wind and wave energy, and historically slowly rising sea levels.¹² The effects of climate change under all current climate modeling scenarios will accelerate changes in the already dynamic character of the Massachusetts coastline¹³ and threaten coastal and estuarine resource areas, including beaches, dunes, salt marshes, and tidal flats.¹⁴ These areas not only serve as habitat and breeding grounds for fish and wildlife, but also support traditional human activities of fishing, fowling, and navigation protected by the Commonwealth's public trust doctrine.¹⁵ Coastal areas, particularly beaches, are also popular venues for a range of recreational activities. Many coastal features, such as dunes, barrier islands, and wetlands, help attenuate coastal flooding and serve as natural buffers between the sea and adjacent private development, public infrastructure, and inland communities.¹⁶ Finally, Massachusetts's coastline continues to be a desirable location for private residential development, and a neces-

¹¹ See COASTAL HAZARDS COMM'N, PREPARING FOR THE STORM: RECOMMENDATIONS FOR MANAGEMENT OF RISK FROM COASTAL HAZARDS IN MASSACHUSETTS 1 (2007); Ken Kimmell & Laurie Burt, *Massachusetts Takes on Climate Change*, 27 UCLA J. ENVTL. L. & POL'Y 295, 306 (2009).

¹² COASTAL HAZARDS COMM'N, *supra* note 11.

¹³ *Id.* at 3. The Coastal Hazards Commission report states that records of tide gauges around Boston, Woods Hole, and Nantucket indicate that, over the past one hundred years, relative sea level—a “combination of rising water surface with land subsidence”—has risen approximately ten inches. *Id.* Further, the International Panel on Climate Change “predicts that SLR and its risk to coastal resources will accelerate over the next 100 years.” *Id.* The report indicates that under conservative projection, by 2100, sea levels could rise anywhere from four to twenty-one inches, whereas under less conservative scenarios, SLR would range from eight to thirty-three inches. *Id.*; see also EXEC. OFFICE OF ENERGY & ENVTL. AFFAIRS (“EEA”) & ADAPTATION ADVISORY COMM., MASSACHUSETTS CLIMATE CHANGE ADAPTATION REPORT 15–17 (2011), available at <http://www.mass.gov/eea/docs/eea/energy/cca/eea-climate-adaptation-report.pdf> (discussing more current SLR modeling and projections).

¹⁴ See EEA & ADAPTATION ADVISORY COMM., *supra* note 13, at 17, 44, 115.

¹⁵ See *id.* at 34; James G. Titus, *Rising Seas, Coastal Erosion, and the Takings Clause: How to Save Wetlands and Beaches Without Hurting Property Owners*, 57 MD. L. REV. 1279, 1363 (1998) (quoting *Arnold v. Mundy*, 6 N.J.L. 1, 76–77 (1821)).

¹⁶ See EEA & ADAPTATION ADVISORY COMM., *supra* note 13, at 108.

sary location for both commercial and recreational water-dependent activities and uses tied to navigation.¹⁷

The frequency and intensity of legal challenges over the highly sensitive balance between private and public coastal property rights will likely increase as climate change accelerates changes in coastlines.¹⁸ As coastlines begin to shift more rapidly, coastal property owners likely will find it necessary to consider whether to resist, increase their resilience to, or ultimately retreat from the encroaching sea.¹⁹ Affected parties in Massachusetts will include private individuals and entities, the Commonwealth, the City of Boston, and other coastal municipalities.²⁰ Private landowners and state and local governments must plan for—instead of merely react to—the reasonably anticipated effects of climate change.²¹

Recent federal and state cases illustrate some of the legal claims likely to be raised by landowners faced with more frequent and abrupt physical changes in coastlines along or near their properties. For instance, in 2010, the U.S. Supreme Court decided *Stop the Beach Renourishment, Inc. v. Florida Department of Environmental Protection*, a case challenging Florida's Beach and Shoreline Preservation Act.²² The Court found that the implementation of state-approved beach renourishment projects did not contravene the established property rights of the plaintiff's members.²³ Thus, the Court held that Florida had not taken private property without just compensation in violation of the Fifth and Fourteenth Amendments of the U.S. Constitution.²⁴ Additionally, private property owners likely will challenge the constitutionality of state and local laws restricting coastal development and those requiring the conservation of undeveloped uplands to accommodate the landward

¹⁷ See PAUL KIRSHEN ET AL., CLIMATE CHANGE AND COASTAL FLOODING IN METRO BOSTON: IMPACTS AND ADAPTATION STRATEGIES 454 (2008) [hereinafter KIRSHEN ET AL., COASTAL FLOODING].

¹⁸ See J. Peter BYRNE, *Rising Seas and Common Law Baselines: A Comment on Regulatory Takings Discourse Concerning Climate Change*, 11 VT. J. ENVTL. L. 625, 626 (2010).

¹⁹ See U.S. CLIMATE CHANGE SCI. PROGRAM, *supra* note 6, at 281.

²⁰ See PAUL H. KIRSHEN ET AL., CLIMATE'S LONG-TERM IMPACTS ON METRO BOSTON (CLIMB): MEDIA SUMMARY 3 (2006) [hereinafter KIRSHEN ET AL., CLIMB].

²¹ Paul Kirshen et al., *Climate Change in Metropolitan Boston*, 20 NEW ENG. J. PUB. POL'Y 89, 97 (2005).

²² FLA. STAT. §§ 161.011–.242 (2012); 130 S. Ct. 2592, 2599–600 (2010).

²³ *Stop the Beach Renourishment, Inc. v. Fla. Dep't of Env'tl. Prot.*, 130 S. Ct. 2592, 2612 (2010).

²⁴ *Id.* at 2613.

migration of coastal natural areas and associated fish and wildlife habitat due to SLR.²⁵

In Massachusetts, the societal need for new legislation, including amendments to the Massachusetts Public Waterfront Act of 1866 (“Chapter 91”), will likely become increasingly evident over time.²⁶ Such amendments would democratically rebalance valuable public and private coastal property rights and associated interests with specific consideration for the broad international scientific consensus on climate change and its effects, including accelerated SLR.²⁷ Additionally, state regulations and policies developed to implement the Commonwealth’s recent environmental legislation, including the Global Warming Solutions Act of 2008, should be used to proactively plan for and help manage the likely effects of climate change, while respecting existing private coastal property interests and affected landowners’ reasonable, investment-backed expectations in the continued and future use of valuable coastal real estate.²⁸

This Article reviews the existing “background principles” of Massachusetts law that relate to coastal property rights and its public trust doctrine.²⁹ Based on this review, it is increasingly clear that property owners’ and the Commonwealth’s attempts to adapt to the effects of climate change, including SLR, will likely strain the long-standing common law principles incorporated into state property law by historical judicial precedent and existing statutes.³⁰ Over time, as the effects of climate change become more frequently experienced, application of these existing principles of law may become so stressed by shifting environmental conditions that they can no longer serve the equitable considerations that they were originally created to address.³¹

This Article examines how existing state laws are likely to create challenges for the implementation of adaptation strategies proposed to address the effects of climate change and uses Massachusetts as a case study. Part I explores the effects of climate change on coastline environments, including the Massachusetts coast.³² Part II reviews adaptation strategies for coastal communities to respond to changing coast-

²⁵ Byrne, *supra* note 18.

²⁶ See *infra* notes 174–206 and accompanying text.

²⁷ See *infra* notes 338–352 and accompanying text.

²⁸ See *infra* notes 298–304 and accompanying text.

²⁹ See *infra* notes 147–231 and accompanying text.

³⁰ See *infra* notes 316–394 and accompanying text.

³¹ See *infra* notes 380–392 and accompanying text.

³² See *infra* notes 36–92 and accompanying text.

lines.³³ Part III provides an overview of Massachusetts statutes and regulations regarding rights of the public and private owners along the coast.³⁴ Part IV then provides an analysis to potential legal challenges to adaptation strategies by reviewing current Takings Clause jurisprudence.³⁵ This Article concludes with preliminary suggestions to balance private property rights with the emerging public policy imperative for climate change adaptation.

I. CLIMATE CHANGE AND LIKELY EFFECTS ON COASTLINES

In recent years, consensus has solidified within the United States and international scientific communities that the planet has entered a period of predominately human-influenced global warming and climate change.³⁶ Specifically, leading climate scientists agree that “[w]arming of the climate system is *unequivocal*, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level.”³⁷ Further, scientists have found that the global warming and climate change “observed over the past 50 years is due primarily to human-induced emissions of heat-trapping gases . . . mainly from the burning of fossil fuels (coal, oil, and gas), with important contributions from the clearing of forests, agricultural practices, and other activities.”³⁸ The observed and predicted effects of climate change on coastlines include 1) accelerated relative or localized SLR; 2) increased frequency and severity of damaging storm surges and associated coastal flooding; 3) amplified storm-related shoreline erosion; and 4) the permanent inundation of low-lying coastal areas, including floodplains and coastal wetlands.³⁹

³³ See *infra* notes 93–146 and accompanying text.

³⁴ See *infra* notes 147–247 and accompanying text.

³⁵ See *infra* notes 248–394 and accompanying text.

³⁶ EEA & ADAPTATION ADVISORY COMM., *supra* note 13, at 12.

³⁷ INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *supra* note 3, at 2 (emphasis added).

³⁸ U.S. GLOBAL CHANGE RESEARCH PROGRAM, GLOBAL CLIMATE CHANGE IMPACTS IN THE UNITED STATES 9 (2009).

³⁹ EEA & ADAPTATION ADVISORY COMM., *supra* note 13, at 16–17; see PETER C. FRUMHOFF ET AL., CONFRONTING CLIMATE CHANGE IN THE U.S. NORTHEAST: SCIENCE, IMPACTS, AND SOLUTIONS 15 (2007).

A. *Effects on the Coastline: Accelerated Sea Level Rise*

Over the last century, global sea levels rose approximately eight inches, despite stable levels over the previous two millennia.⁴⁰ Further “[s]atellite data available over the past 15 years show sea level rising at a rate roughly double the rate observed over the past century.”⁴¹ Indeed, records of tide gauges in Massachusetts around Boston, Woods Hole, and Nantucket demonstrate relative SLR of roughly ten inches over last century.⁴² As detailed in scientific assessments and reports, accelerated SLR results from a combination of ocean water expanding as its temperature rises and the melting of glaciers and major ice sheets.⁴³ In Massachusetts, localized land subsidence and shifting currents further amplify these factors.⁴⁴ Current rates of SLR and the varied projections for accelerated trends over the twenty-first century present serious threats to the coastal communities of Massachusetts.⁴⁵

More generally, predicting relative SLR presents challenges. Although scientists can accurately model effects of thermal expansion and melting glaciers, the complex processes controlling the seaward movements and melting of polar ice sheets are less understood and thus harder to model.⁴⁶ Despite these present uncertainties, “[c]ontinued [greenhouse gas] emissions at or above current rates would cause further warming and induce many changes in the global climate system during the 21st century that would *very likely* be larger than those observed during the 20th century.”⁴⁷ Due to current limits in scientific certainty of some important drivers of SLR, the Intergovernmental Panel on Climate Change (“IPCC”) 2007 Report does not address the upper bounds of SLR.⁴⁸

SLR projections for the twenty-first century are evolving rapidly due in part to the variables and current scientific uncertainties identi-

⁴⁰ U.S. GLOBAL CHANGE RESEARCH PROGRAM, *supra* note 38, at 18.

⁴¹ *Id.*

⁴² COASTAL HAZARDS COMM’N, *supra* note 11, at 3.

⁴³ FRUMHOFF ET AL., *supra* note 39, at 16; U.S. GLOBAL CHANGE RESEARCH PROGRAM, *supra* note 38, at 18.

⁴⁴ EEA & ADAPTATION ADVISORY COMM., *supra* note 13, at 15–16.

⁴⁵ *Id.* at 16.

⁴⁶ U.S. GLOBAL CHANGE RESEARCH PROGRAM, *supra* note 38, at 25.

⁴⁷ INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *supra* note 3, at 7.

⁴⁸ *Id.* The IPCC’s projections for global SLR include contributions from increased Greenland and Antarctic ice flows at rates observed between 1993 and 2003, but do not include estimates for future changes in polar ice sheet flow rates. *Id.* at 8.

fied above.⁴⁹ The IPCC's projections, though conservative, are credible and internationally recognized.⁵⁰ Based on several different greenhouse gas ("GHG") emission scenarios, the IPCC projects SLR by 2100 could be: seven inches with low emissions; nineteen inches with mid-level emissions; and twenty-three inches with high emissions.⁵¹ In contrast, another report that includes melt from land ice in its estimates predicts much higher global SLR under all emission scenarios: thirty-one inches under low emissions; thirty-three inches under mid-level emissions; and seventy-nine inches under high emissions.⁵² Additionally, other recent studies predict that changes in the Atlantic sea currents could cause SLR beyond the predicted global mean.⁵³

B. *Effects on the Coastline: Increased Frequency and Extent of Storm-Related Coastal Flooding*

Coastal areas become increasingly vulnerable to storms as sea levels rise.⁵⁴ Additionally, land subsidence and changes in storminess can escalate the effects of storm-related coastal flooding.⁵⁵ Specifically, along the U.S. East Coast, long-term storm climatology has not changed, but storm surge impacts have increased.⁵⁶ SLR and other factors such as existing coastal development have already significantly affected many U.S. coastal areas.⁵⁷ Current flood data indicate an increased frequency of flooding in low-lying regions from storm surges and spring tides.⁵⁸

Combined with accelerated SLR, present storm climatology and storm surge frequency distributions lead to "forecasts of more severe coastal flooding. . . higher potential flood levels and more frequent

⁴⁹ See U.S. GLOBAL CHANGE RESEARCH PROGRAM, *supra* note 38, at 25–26 (noting the complexity of predicting future sea level rise).

⁵⁰ EEA & ADAPTATION ADVISORY COMM., *supra* note 13, at 16.

⁵¹ *Id.*

⁵² W. T. Pfeffer et al., *Kinematic Constraints on Glacier Contributions to 21st-Century Sea-Level Rise*, 321 SCI. 1340, 1340, 1342 (2008).

⁵³ Aixue Hu et al., *Transient Response of the MOC and Climate to Potential Melting of the Greenland Ice Sheet in the 21st Century*, GEOPHYSICAL RES. LETTERS, May 2009, at 1, 3–5; Jianjun Yin et al., *Model Projections of Rapid Sea-Level Rise on the Northeast Coast of the United States*, NATURE GEOSCIENCE, Apr. 2009, at 262, 262.

⁵⁴ See Cynthia Rosenzweig et al., *Assessment of Observed Changes and Responses in Natural and Managed Systems*, in CONTRIBUTION OF WORKING GROUP II TO THE FOURTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2007: IMPACTS, ADAPTATION AND VULNERABILITY 79, 92–93 (M.L. Parry et al. eds., 2007).

⁵⁵ *Id.* at 92.

⁵⁶ *Id.*

⁵⁷ See U.S. CLIMATE CHANGE SCI. PROGRAM, *supra* note 6, at 60; Rosenzweig et al., *supra* note 54, at 92–93.

⁵⁸ U.S. CLIMATE CHANGE SCI. PROGRAM, *supra* note 6, at 60.

flooding at levels rarely experienced today.”⁵⁹ A study of coastal flooding along the northeastern United States and Massachusetts coastlines, using conservative SLR projections from the IPCC’s 2007 Assessment, shows substantial increases in the frequency and heights of today’s one hundred-year floods.⁶⁰ The study predicts that by the middle of the twenty-first century, such floods will occur on average every two to three years in Boston.⁶¹ By 2100, Boston will experience these floods every year or two on average.⁶² Further, the study predicts increases in today’s one hundred-year maximum flood height in Boston by at least two additional feet under high emission scenarios by 2100.⁶³ Notably, SLR changes alone affect these projections, which do not include other potential climate change-induced shifts in shoreline position, changes in storm frequency, intensity, or track, or the accelerated melting of polar ice sheets.⁶⁴

C. *Effects on the Coastline: Coastal Erosion of Beaches, Banks, and Dunes*

According to the IPCC, SLR *probably* contributes to coastal erosion.⁶⁵ Such erosion impacts the U.S. East Coast, “where 75% of the shoreline removed from the influence of spits, tidal inlets and engineering structures is eroding.”⁶⁶ Scientists already consider coastline erosion to be a significant problem in many parts of the Northeast.⁶⁷ In addition to historical SLR, coastal erosion comes from other natural factors and physical processes such as waves, storms, sediment supply, human activity, and the geological character of the coast.⁶⁸

Nationally, federal agencies predict that as sea level rises at rates higher than those observed over the past century, coastal erosion will *probably* increase.⁶⁹ The character of coastal landforms—such as barrier islands and cliffs—will be important variables influencing the precise

⁵⁹ Christopher B. Field et al., *North America*, in WORKING GROUP II, *supra* note 54, at 617, 630.

⁶⁰ FRUMHOFF ET AL., *supra* note 39, at 18.

⁶¹ *Id.* at 19 (using the IPCC’s current high and low emission scenarios, respectively).

⁶² *Id.* (using both high and low emission scenarios).

⁶³ *Id.*

⁶⁴ *Id.*

⁶⁵ Rosenzweig et al., *supra* note 54, at 92.

⁶⁶ *Id.*

⁶⁷ FRUMHOFF ET AL., *supra* note 39, at 25.

⁶⁸ EEA & ADAPTATION ADVISORY COMM., *supra* note 13, at 113; U.S. CLIMATE CHANGE SCI. PROGRAM, *supra* note 6, at 62.

⁶⁹ U.S. CLIMATE CHANGE SCI. PROGRAM, *supra* note 6, at 23.

manner and speed at which these changes occur.⁷⁰ In sandy shore environments, however, coastal headlands, spits, and barrier islands are *virtually certain* to erode more quickly.⁷¹ For example, Cape Cod, Massachusetts, already experiences coastal erosion and beach loss.⁷² Further, the south shore of Nantucket Island, which had lost about 2600 feet of land total to the Atlantic Ocean in the past three hundred years, now loses about fifteen feet of land each year.⁷³

Although strong scientific consensus exists that climate change accelerates SLR and affects coastal regions, many uncertainties still complicate any detailed predictions on how coastlines will respond.⁷⁴ As a product of the complex interactions between these factors, coastal scientists face difficulty in predicting how shorelines will change in response to SLR.⁷⁵ Despite these uncertainties, coastal erosion may present significant problems for coastal properties because the rate of erosion is typically much greater than the vertical rise in sea level.⁷⁶ Consequently, the results of such erosion could be more dramatic than accelerated SLR alone.⁷⁷ Some scientists maintain that barrier islands, wetlands, and other parts of coastal systems may have tipping points: when certain limits or thresholds are exceeded, these coastal landforms will become unstable and undergo large, rapid, and largely irreversible changes.⁷⁸

D. *Effects on the Coastline: Loss and Migration of Coastal Wetlands*

In the northeastern United States, relative SLR already threatens coastal wetlands.⁷⁹ These areas provide key ecological functions and services: protecting coastal areas from the effects of waves, flooding, and erosion; filtering pollutants and nutrients within the coastal area; providing nursery grounds for commercially valuable fish and shellfish; and serving as a home for waterfowl, migratory birds, and threatened and endangered wildlife.⁸⁰ Historically, the Northeast's Atlantic coast

⁷⁰ *Id.*

⁷¹ *Id.* Importantly, the mid-Atlantic coast is entirely comprised of these sandy shore environments. *Id.* at 23–24.

⁷² FRUMHOFF ET AL., *supra* note 39, at 27.

⁷³ *See id.*

⁷⁴ U.S. CLIMATE CHANGE SCI. PROGRAM, *supra* note 6, at 64.

⁷⁵ *See id.*

⁷⁶ FRUMHOFF ET AL., *supra* note 39, at 25.

⁷⁷ *See id.*

⁷⁸ U.S. CLIMATE CHANGE SCI. PROGRAM, *supra* note 6, at 64.

⁷⁹ FRUMHOFF ET AL., *supra* note 39, at 27.

⁸⁰ EEA & ADAPTATION ADVISORY COMM., *supra* note 13, at 113; FRUMHOFF ET AL., *supra* note 39, at 27–28; U.S. CLIMATE CHANGE SCI. PROGRAM, *supra* note 6, at 114.

marshes have naturally accumulated or accreted sediment and organic matter sufficient to maintain their elevation.⁸¹

As a result of climate change, coastal wetlands, including salt marshes, are particularly sensitive to long-term SLR.⁸² As their locations are linked intimately to sea level, such wetlands are at risk of inundation.⁸³ Some salt marshes in less developed areas may avoid impacts of SLR through sufficient vertical accretion.⁸⁴ In developed coastal communities, however, accelerated SLR will likely cause loss of salt marshes and other important coastal resource areas.⁸⁵ Specifically, these areas likely will not be able to maintain adequate accretion rates to counter the effects of SLR because of a predicted reduction of sediment load.⁸⁶ In more developed areas, accelerated SLR will increase rates of wetland loss due in part to “coastal squeeze”—human development and localized physical characteristics such as wave energy and slope—that constrain landward migration of wetlands.⁸⁷

Losses of ecological functions associated with coastal wetlands will also have important societal consequences.⁸⁸ Specifically, wetland losses leave developed and urbanized coastal areas more vulnerable to flooding and storm-related erosion.⁸⁹ Thus, more pollutants can enter and contaminate coastal waters, reducing the habitat quality of these highly productive natural areas, harming many animal species, and threatening commercially significant fish and shellfish populations.⁹⁰ Scientists have found that it is *virtually certain* that tidal wetlands experiencing submergence will continue to lose ground to the sea in response to future accelerated SLR and other climate changes.⁹¹ In addition, an overall increase in tidal wetland area in the United States over the next one

⁸¹ FRUMHOFF ET AL., *supra* note 39, at 28. See U.S. CLIMATE CHANGE SCI. PROGRAM, *supra* note 6, at 194–202, for a more detailed review of vertical development of coastal wetlands and the influence of climate change.

⁸² See EEA & ADAPTATION ADVISORY COMM., *supra* note 13, at 44. Salt marshes are “located between the high spring tide and mean tide levels of protected coastal shores.” *Id.* These areas provide food and habitat for important marine and terrestrial wildlife. *Id.*

⁸³ See Robert J. Nicholls et al., *Coastal Systems and Low-Lying Areas*, in WORKING GROUP II, *supra* note 54, at 328.

⁸⁴ Field et al., *supra* note 59.

⁸⁵ *See id.*

⁸⁶ EEA & ADAPTATION ADVISORY COMM., *supra* note 13, at 44.

⁸⁷ Nicholls et al., *supra* note 83, at 329; *see also* U.S. CLIMATE CHANGE SCI. PROGRAM, *supra* note 6, at 202–04 (detailing the physical factors influencing the likelihood of successful horizontal migration of coastal wetlands).

⁸⁸ *See* U.S. CLIMATE CHANGE SCI. PROGRAM, *supra* note 6, at 27.

⁸⁹ FRUMHOFF ET AL., *supra* note 39, at 15, 28.

⁹⁰ *Id.* at 28.

⁹¹ U.S. CLIMATE CHANGE SCI. PROGRAM, *supra* note 6, at 208.

hundred years is *very unlikely*, given current wetland loss rates and the relatively few successful examples of natural development of new tidal wetlands.⁹²

II. ADAPTATION BY COASTAL COMMUNITIES AND IN COASTAL AREAS

An extensive body of literature published internationally, nationally, and locally provides guidance on ways coastal communities can adapt to the anticipated effects of climate change on human development and natural resources.⁹³ Coastal adaptation responses include managing coastal systems to reduce risks related to current climate extremes and variability; implementing sustainable development practices; and developing better models.⁹⁴ As described by the Intergovernmental Panel on Climate Change (“IPCC”):

Adaptation to climate change takes place through adjustments to reduce vulnerability or enhance resilience in response to observed or expected changes in climate and associated extreme weather events. Adaptation occurs in physical, ecological and human systems. It involves changes in social and environmental processes, perceptions of climate risk,

⁹² *Id.*

⁹³ See BOS. CLIMATE ADAPTATION WORK GRP., ADAPTATION RECOMMENDATIONS 1–3 (2010) (outlining elements and strategies of an adaptation plan for the city of Boston); INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *supra* note 3, at 14–18 (detailing adaptation and mitigation options); KIRSHEN ET AL., COASTAL FLOODING, *supra* note 17, at 461–63 (outlining adaptation scenarios for metro Boston); Nicholls et al., *supra* note 83, at 340–45 (discussing adaption practice, options, and constraints); Drake Bennett, *Defending Boston from the Sea*, BOS. GLOBE, June 6, 2010, at K1 (discussing Boston’s need for adaptation and outlining specific strategies to protect the city from rising sea levels); *Coastal Areas Impacts & Adaptation*, U.S. ENVTL. PROT. AGENCY, <http://www.epa.gov/climatechange/impacts-adaptation/coasts.html#adapt> (last updated Apr. 22, 2013) (providing adaptation examples for coastal areas). See generally PEW CTR. ON GLOBAL CLIMATE CHANGE, ADAPTATION PLANNING—WHAT U.S. STATES AND LOCALITIES ARE DOING (2007) (discussing adaptation plans in various states and localities); COASTAL STATES ORG. CLIMATE CHANGE WORK GRP., THE ROLE OF COASTAL ZONE MANAGEMENT PROGRAMS IN ADAPTATION TO CLIMATE CHANGE (2007) (discussing the role of coastal zone management programs within adaptation strategies); NE. REG’L OCEAN COUNCIL, COASTAL HAZARDS RESILIENCE COMMITTEE: 2009–2010 WORK PLAN (2008) (promoting development of adaption strategies within the northeast United States); W. Neil Adger et al., *Assessment of Adaptation Practices, Options, Constraints and Capacity*, in WORKING GROUP II, *supra* note 54, at 717 (discussing adaptation practices and options); HEINZ CTR. & CERES, RESILIENT COASTS: A BLUEPRINT FOR ACTION (2009) (discussing the critical need for adaptation plans and identifying adaptation principles); *Climate Ready Estuaries*, U.S. ENVTL. PROT. AGENCY, <http://water.epa.gov/type/occb/cre/index.cfm> (last updated Jan. 10, 2013) (providing resources for managers to develop and implement adaptation techniques).

⁹⁴ Nicholls et al., *supra* note 83, at 341.

practices and functions to reduce potential damages or to realise new opportunities. Adaptations include anticipatory and reactive actions, private and public initiatives, and can relate to projected changes in temperature and current climate variations and extremes that may be altered with climate change. In practice, adaptations tend to be on-going processes, reflecting many factors or stresses, rather than discrete measures to address climate change specifically. . . . [As used by the IPCC], adaptation practices refer to actual adjustments, or changes in decision environments, which might ultimately enhance resilience or reduce vulnerability to observed or expected changes in climate. Thus, investment in coastal protection infrastructure to reduce vulnerability to storm surges and anticipated sea-level rise is an example of actual adjustments.⁹⁵

This Part provides an overview of possible adaptation responses or options that communities may utilize.⁹⁶ As coastlines and coastal resource areas increasingly experience the effects of climate change, coastal communities can better understand the dynamics of three major strategies: protection and resistance, accommodation and resilience, and mandatory retreat and relocation.⁹⁷

Adaptation in coastal areas will be more challenging in developing countries than in developed countries such as the United States because of social constraints, limited financial resources, and overall lack of adaptive capacity.⁹⁸ Developed countries may have fewer obstacles, but these challenges are still pressing.⁹⁹ The IPCC 2007 Assessment noted that under present climate conditions, adaptation to coastal hazards is often inadequate in North America.¹⁰⁰ Further, coastal communities generally are not ready for increased exposure to storms.¹⁰¹

Americans are both coastal and increasingly urban. Almost forty percent of Americans live in counties along the coastal shoreline.¹⁰² In addition, roughly eighty percent of North Americans live in urban ar-

⁹⁵ Adger et al., *supra* note 93, at 720.

⁹⁶ See *infra* notes 98–146 and accompanying text.

⁹⁷ See *infra* notes 113–146 and accompanying text.

⁹⁸ See INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *supra* note 3, at 14; W. Neil Adger et al., *supra* note 93, at 719.

⁹⁹ See INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *supra* note 3, at 14.

¹⁰⁰ Field et al., *supra* note 59, at 623.

¹⁰¹ *Id.*

¹⁰² NATIONAL COASTAL POPULATION REPORT: POPULATION TRENDS FROM 1970 TO 2020, NAT'L OCEANIC & ATMOSPHERIC ADMIN. 4 (2013).

eas.¹⁰³ Although largely shielded from the natural environment by technology and advanced infrastructure, the devastating effects of Atlantic hurricanes in the early twenty-first century, such as Hurricane Katrina in 2005, highlight the vulnerability of existing public and private infrastructure.¹⁰⁴ Individuals and communities are not prepared for the effects of coastal hazards, anticipated to increase in frequency.¹⁰⁵ Based on the existing scientific data and climate change predictions, Massachusetts faces a critical timing threshold to adequately plan for the effects of climate change-induced sea level rise (“SLR”) on the coast.¹⁰⁶ The Commonwealth has an opportunity to implement measures to successfully adapt existing private and public development, land uses, and infrastructure.¹⁰⁷

In the Boston area, Paul Kirshen and other researchers involved in the Climate’s Long-term Impacts on Metro Boston (“CLIMB”) study have analyzed possible adaptation strategies in response to climate change and predicted coastal flooding.¹⁰⁸ The CLIMB study, a multidisciplinary research project conducted between 1999 and 2004, assessed the potential impacts of climate change on infrastructure within the metropolitan Boston area (“metro Boston”).¹⁰⁹ The study recommended adaptation strategies to prevent, reduce, and manage climate change-related risks.¹¹⁰ Among other reviewed areas, the CLIMB study analyzed how predicted accelerated SLR would likely affect metro Boston’s existing environment and infrastructure.¹¹¹ The CLIMB study assessed the effects of climate change and coastal flooding within metro Boston, stretching from the northern town of Ipswich to the southern town of Duxbury.¹¹²

A. Protection and Resistance

Protection and resistance initiatives utilize human engineering capabilities to guard inland areas from the potentially destructive forces

¹⁰³ Field et al., *supra* note 59, at 625.

¹⁰⁴ *Id.*

¹⁰⁵ *See id.* at 630.

¹⁰⁶ KIRSHEN ET AL., CLIMB, *supra* note 20, at 1–3.

¹⁰⁷ *Id.* at 3.

¹⁰⁸ KIRSHEN ET AL., CLIMB FINAL REPORT 5, 54 (2004) [hereinafter KIRSHEN ET AL., CLIMB FINAL REPORT].

¹⁰⁹ KIRSHEN ET AL., COASTAL FLOODING, *supra* note 17.

¹¹⁰ KIRSHEN ET AL., CLIMB FINAL REPORT, *supra* note 108, at 154–62.

¹¹¹ *See id.* at 54–68.

¹¹² *Id.* at 54.

of the sea.¹¹³ Protection and resistance strategies for climate change and its effects on coastlines offer opportunities for communities to adapt to new circumstances.¹¹⁴ The CLIMB study specifically identified this as a “Build Your Way Out” scenario.¹¹⁵ Through increased reliance on and use of “hard” engineering coastal structures including seawalls, bulkheads, and storm surge barriers, this strategy allows for continued growth in floodplain areas without climate change-related land use restrictions.¹¹⁶ These areas receive protection from retrofitted or new coastal structures designed to withstand the accelerated SLR and increased coastal flooding predicted in the twenty-first century.¹¹⁷

Such strategies have corresponding drawbacks. Namely, this approach interrupts the natural movements and replenishment of sediment to coastal resource areas, such as beaches and dunes.¹¹⁸ Protection measures also may create physical barriers to the horizontal, landward migration of these coastal natural areas as accelerated SLR occurs.¹¹⁹ If engineered solutions inadequately protect against SLR that actually occurs over the twenty-first century, increased development density and risk within floodplains areas would be problematic.¹²⁰

In contrast, “soft” engineering options may provide a “greener” alternative to adaptation via the hard engineering solutions described above. Soft engineering options include protection of existing natural barriers and resource areas via beach nourishment and dune reconstruction.¹²¹ Advantages of soft coastal techniques include greater ecological sensitivity, continued use of coastal resource areas by fish and wildlife,¹²² and greater likelihood of supporting the preservation of tra-

¹¹³ U.S. CLIMATE CHANGE SCI. PROGRAM, *supra* note 6, at 282–83 (“The term ‘shore protection’ generally refers to a class of coastal engineering activities that reduce the risk of flooding, erosion, or inundation of land and structures.”).

¹¹⁴ See KIRSHEN ET AL., CLIMB, *supra* note 20, at 2.

¹¹⁵ KIRSHEN ET AL., CLIMB FINAL REPORT, *supra* note 108, at 80.

¹¹⁶ *Id.* at 58; KIRSHEN ET AL., CLIMB, *supra* note 20, at 2; see U.S. CLIMATE CHANGE SCI. PROGRAM, *supra* note 6, at 282–95 (describing shore protection strategies generally).

¹¹⁷ See KIRSHEN ET AL., CLIMB FINAL REPORT, *supra* note 108, at 58.

¹¹⁸ *Id.*

¹¹⁹ See *id.*

¹²⁰ See *id.*

¹²¹ REBECCA HANEY ET AL., BEACH NOURISHMENT: MASSDEP’S GUIDE TO BEST MANAGEMENT PRACTICES FOR PROJECTS IN MASSACHUSETTS 6 (2007); see U.S. CLIMATE CHANGE SCI. PROGRAM, *supra* note 6, at 290.

¹²² Projects need to be implemented in consideration of existing rare species habitat.

ditional public access along shorelines and within both Private and Commonwealth Tidelands.¹²³

Soft engineering options are not without corresponding drawbacks, as well. Disadvantages of soft engineering solutions include the frequency of repeated beach nourishment and reconstruction maintenance, which is likely to increase as SLR accelerates.¹²⁴ Soft engineering strategies may also cause off-site environmental impacts to sediment source dredging locations.¹²⁵ In addition, if the public does not own in fee simple the artificially-nourished beaches, frequent nourishment projects with imported sediment become a very questionable public investment in private property, or alternatively an increasingly expensive activity for private landowners to undertake and sustain.¹²⁶

B. Accommodation and Resilience

Accommodation and resilience adaptation strategies have low environmental impacts, preemptively adjusting to climate change and SLR effects.¹²⁷ This approach can include floodplain regulations stricter than the current Federal Emergency Management Agency (“FEMA”) floodplain regulations.¹²⁸ As outlined in the CLIMB study, this “green” adaptation scenario would require flood-proofing all new development within FEMA’s mapped one hundred- and five hundred-year floodplains.¹²⁹ The plan would require current residential structures within these floodplain zones to be flood-proofed upon resale.¹³⁰ Further, development within the one hundred-year floodplain must have living space elevated above the first floor.¹³¹ Outside the FEMA zone, developers must wet flood-proof buildings, allowing floodwaters to enter the home but preventing structural damage.¹³²

¹²³ See HANEY ET AL., *supra* note 121, at 3; U.S. CLIMATE CHANGE SCI. PROGRAM, *supra* note 6, at 309, 369; *infra* notes 182–190 and accompanying text (describing Private and Commonwealth Tidelands).

¹²⁴ See KIRSHEN ET AL., CLIMB FINAL REPORT, *supra* note 108, at 59 (observing that maintenance of beach nourishment projects to prevent foreshore erosion and undercutting can be high and necessary every five to ten years); U.S. CLIMATE CHANGE SCI. PROGRAM, *supra* note 6, at 260–61, 290 (discussing the need for periodic renourishment).

¹²⁵ See U.S. CLIMATE CHANGE SCI. PROGRAM, *supra* note 6, at 318–19.

¹²⁶ See *id.* at 376.

¹²⁷ See KIRSHEN ET AL., CLIMB FINAL REPORT, *supra* note 108, at 59.

¹²⁸ See *id.*

¹²⁹ *Id.*

¹³⁰ *Id.*

¹³¹ *Id.*

¹³² *Id.*

In addition to the “green” strategy outlined in the CLIMB study, the Massachusetts Executive Office of Energy and Environmental Affairs (“EEA”) has considered other accommodation strategies to deal with the effects of climate change.¹³³ The EEA’s 2011 Climate Change Adaptation Report (“Adaptation Report”) recommends strategies to address vulnerabilities of commercial and residential developments, ports, and public infrastructure located within the Commonwealth’s coastal zone.¹³⁴ The Adaptation Report recommends reducing construction on vulnerable coastal areas.¹³⁵ It also promotes consideration of a statewide “rolling easement” policy for existing development along the shoreline while preventing protection measures.¹³⁶

Accommodation and resilience strategies could face legal contests.¹³⁷ The likely legality of some and illegality of other accommodation and resilience adaptation strategies are the primary subject of this Article’s review of existing laws—both common law and statutory-based—and legal analysis.¹³⁸ Specifically, this Article examines those strategies presently suggested by the EEA in its recently released Adaptation Report.¹³⁹

C. Mandatory Retreat and Relocation

Finally, communities can choose to avoid the impacts of accelerated SLR on the coast through either the physical relocation of infrastructure or its abandonment.¹⁴⁰ Under retreat and relocation strategies, decreased or moved development can lead to increased natural buffers against coastline changes.¹⁴¹ Typical retreat and relocation projects include relocating existing development out of floodplains, prohibiting new buildings within floodplains and coastal areas identified to be at risk from increased coastal flooding, and prohibiting rebuilding of existing development after flooding occurs.¹⁴² A retreat policy likely

¹³³ EEA & ADAPTATION ADVISORY COMM., *supra* note 13, at 1.

¹³⁴ *Id.* at 108, 111–13.

¹³⁵ *Id.* at 111.

¹³⁶ *Id.* at 112. *See infra* notes 353–356 and accompanying text (discussing rolling easements).

¹³⁷ *See infra* notes 248–249 and accompanying text.

¹³⁸ *See infra* notes 248–312 and accompanying text.

¹³⁹ *See infra* notes 353–394 and accompanying text.

¹⁴⁰ KIRSHEN ET AL., CLIMB FINAL REPORT, *supra* note 108, at 159; U.S. CLIMATE CHANGE SCI. PROGRAM, *supra* note 6, at 295.

¹⁴¹ KIRSHEN ET AL., CLIMB FINAL REPORT, *supra* note 108, at 159.

¹⁴² COASTAL HAZARDS COMM’N, *supra* note 11, at 3; KIRSHEN ET AL., CLIMB FINAL REPORT, *supra* note 108, at 159.

would not set a damage threshold below which private landowners could repair coastal property, but instead would promote property abandonment.¹⁴³

Despite the benefits of such strategies, property rights and land use will often make retreat strategies difficult to achieve.¹⁴⁴ In the United States, and specifically within the Commonwealth of Massachusetts, mandatory retreat and relocation adaptation strategies are very likely to trigger significant legal challenges.¹⁴⁵ Given the state and federal jurisprudence of the nature of private property rights, as further discussed and analyzed in this Article, landowners may challenge—and may even defeat—governmental actions intended to thwart existing land uses, activities, and coastal developments.¹⁴⁶

III. RELEVANT MASSACHUSETTS STATUTES AND REGULATIONS

A. *Massachusetts Bay Colonial Ordinance of 1641–1647*

Still recognized and repeatedly cited in waterfront property disputes today, the legacy of the Massachusetts Bay Colonial Ordinance of 1641–47 (“Colonial Ordinance” or “Ordinance”) plays an important role in shaping the legally complex landscape of public and private rights to, and ownership of, tidelands within the Commonwealth.¹⁴⁷ Originally found in the 1641 colonial Body of Libertyes, the Ordinance was first codified in the 1649 Book of General Lawes and Libertyes.¹⁴⁸ The Colonial Ordinance identifies and continues to inform the types of public and private uses allowed in so-called “Private Tidelands.”¹⁴⁹ Justice Joseph Story prepared the 1814 edition of public laws, entitled

¹⁴³ See KIRSHEN ET AL., COASTAL FLOODING, *supra* note 17, at 463.

¹⁴⁴ *Id.* at 467; see Titus, *supra* note 15, at 1286, 1318.

¹⁴⁵ See TITUS, *supra* note 4, at 104; *infra* notes 248–312 and accompanying text.

¹⁴⁶ See, e.g., BYRNE, *supra* note 18 (noting the tension that will arise between common law regarding erosion and private owners’ incentives to change it); Titus, *supra* note 15, at 1326, 1334 (noting implications of tidelands regulations on the Takings Clause).

¹⁴⁷ 63 Mass. Bay Colony, Gen. Lawes & Libertyes, Liberties Common (1641) (amended 1647), reprinted in *The Book of the General Lawes and Libertyes Concerning the Inhabitants of the Massachusetts* §§ 2–4 (Thomas G. Barnes ed., The Huntington Library 1975) (1648) [hereinafter Colonial Ordinance]; see also *Arno v. Commonwealth*, 931 N.E.2d 1, 18–19 (Mass. 2010); 310 MASS. CODE REGS. 9.02 (2012).

¹⁴⁸ *Bos. Waterfront Dev. Corp. v. Commonwealth*, 393 N.E.2d 356, 359 (Mass. 1979).

¹⁴⁹ See *Arno*, 931 N.E.2d at 18–19; *Bos. Waterfront Dev. Corp.*, 393 N.E.2d at 359. Reflecting the Ordinance, the Massachusetts Code of Regulations defines Private Tidelands as lying “landward of the historic low water mark or of a line running 100 rods (1650 feet) seaward of the historic high water mark, whichever is farther landward.” 310 MASS. CODE REGS. 9.02.

“Ancient Charters and Laws of the Colony and Province of Massachusetts Bay,” which contains the Colonial Ordinance in its final form.¹⁵⁰

The Colonial Ordinance provides specific public rights in Private Tidelands and broad private rights of appropriation therein.¹⁵¹ For the public, the Colonial Ordinance establishes that “[e]very inhabitant who is an [sic] householder shall have free fishing and fowling in any great ponds, bays, coves and rivers . . . unless the freemen of the same town or the general court have otherwise appropriated them.”¹⁵² It also declares:

[I]n all creeks, coves, and other places about and upon salt water, where the sea ebbs and flows, the proprietor, or the land adjoining, shall have propriety to the low water mark, where the sea doth not ebb above a hundred rods, and not more wheresoever it ebbs further:

Provided, that such proprietor shall not by this liberty have power to stop or hinder the passage of boats or other vessels, in or through any sea, creeks or coves, to other men’s houses or lands.¹⁵³

From a plain reading of the text of this Ordinance, there is only one stated use restriction on lands appropriated by private landowners within the tidal flats.¹⁵⁴ Namely, the private landowner’s use must not unreasonably interfere with navigation.¹⁵⁵

¹⁵⁰ MOSES M. FRANKEL, *LAW OF SEASHORE WATERS AND WATER COURSES: MAINE AND MASSACHUSETTS* 3 (1969).

¹⁵¹ See Colonial Ordinance, *supra* note 147, §§ 2–4; 310 MASS. CODE REGS. 9.02.

¹⁵² Colonial Ordinance, *supra* note 147, § 2 (emphasis added).

¹⁵³ *Id.* § 3. As the Massachusetts Supreme Judicial Court (SJC) observed in its 1974 Opinion of the Justices (*1974 Opinion*), “[a]lthough strictly the ordinance was limited to the area of the Massachusetts Bay Colony, it has long been interpreted as effecting a grant of the tidal land to all coastal owners in the Commonwealth.” 313 N.E.2d 561, 566 (Mass. 1974) (citing *Weston v. Sampson*, 62 Mass. (8 Cush.) 347, 353–354 (1851)). The 1974 Opinion continues:

The language of the ordinance well illustrates the notion, previously alluded to, of reserved public right. It expressly specifies that the public is to retain the rights of fishing, fowling and navigation. Notwithstanding these limitations and the use of such ambiguous terms as “propriety” and “liberty,” there is ample judicial authority to the effect that the ordinance is properly construed as granting the benefitted owners a fee in the seashore to the extent described and subject to the public rights reserved. It is unnecessary to cite more than a few of the many cases to that effect.

Id.

¹⁵⁴ See Colonial Ordinance, *supra* note 147, § 3.

¹⁵⁵ See *id.*; *Arno*, 931 N.E.2d at 13.

Judges in Massachusetts have reviewed the rights in Private Tidelands granted to littoral landowners by the Colonial Ordinance for over two centuries.¹⁵⁶ The Ordinance imposes a condition that construction between the mean high and historic mean low water marks cannot materially impair navigation by the public so as to constitute a public nuisance.¹⁵⁷ From the Colonial Ordinance, a private littoral landowner gains a real or proprietary title to the soil of the tidelands itself and “as long as he does not unreasonably interfere with navigation,” can build in these flats so as to exclude the public.¹⁵⁸

In its 1979 decision in *Boston Waterfront Development Corp. v. Commonwealth*, the Massachusetts Supreme Judicial Court (“SJC”) noted that “[n]ineteenth century opinions of the [SJC] construed th[e] colonial ordinance as granting ‘only a qualified property’ in the flats to the upland owner, qualified by the public right of navigation.”¹⁵⁹ Elaborating on and consistent with its opinion in the 1822 case *Commonwealth v. Charlestown*, the SJC found that the long-recognized ownership of land to the low water mark came with a condition.¹⁶⁰ The SJC quoted its own language from the 1827 case *Kean v. Stetson*, stating, “[i]t is true individuals may acquire the right by grant or prescription, or under the ordinance of 1641, to occupy flats with wharves and stores, but this is always on condition that the navigation of the stream be not materially impaired.”¹⁶¹

The SJC’s 1974 *Opinion of the Justices* (“1974 Opinion”) also provides insight on the extent of the private real property interests and title that can be gained by private landowners versus public interests reserved in Private Tidelands.¹⁶² Citing its prior case law, the SJC observed that any private ownership below the mean high water mark, including “a real or proprietary title to, and interest in, the soil itself,” granted within tidal flats by the Colonial Ordinance, is “made perfect” except against public rights reserved for therein, specifically “fishing,

¹⁵⁶ See, e.g., *Arno*, 931 N.E.2d at 13; *Commonwealth v. Charlestown*, 18 Mass. (1 Pick.) 180, 183–84 (1822).

¹⁵⁷ *Charlestown*, 18 Mass. (1 Pick.) at 183–84 (noting that an owner can build wharves so long as they do not interrupt navigation); see Colonial Ordinance, *supra* note 147, § 3.

¹⁵⁸ *1974 Opinion*, 313 N.E.2d at 566.

¹⁵⁹ *Bos. Waterfront Dev. Corp.*, 393 N.E.2d at 360.

¹⁶⁰ *Id.*; *Charlestown*, 18 Mass (1 Pick.) at 183–84.

¹⁶¹ *Bos. Waterfront Dev. Corp.*, 393 N.E.2d at 360–61 (quoting *Kean v. Stetson*, 22 Mass. (5 Pick.) 492, 495 (1827) and citing several other SJC opinions from the 1800s and early 1900s).

¹⁶² *1974 Opinion*, 313 N.E.2d at 556.

fowling and navigation.”¹⁶³ In this same 1974 Opinion, however, the SJC also noted that they “have frequently had occasion to declare the limited nature of public rights in the seashore. For example, a littoral owner may build on his tidal land so as to exclude the public completely as long as he does not unreasonably interfere with navigation.”¹⁶⁴ They observed that cases “interpreting the right of the public in navigation all deal with the use in boats or other vessels of the area below mean high water mark when covered with tide water.”¹⁶⁵ The SJC noted that although the reserved public right of fishing includes digging for clams in the flats, this right does not include the taking of “five cords of muscle mud” —which includes soil, clay, and shellfish, either living or dead.¹⁶⁶

Importantly, the Justices were unable to identify any authority relating to the rights of the public to walk on the beach or “to use otherwise private beaches for public bathing.”¹⁶⁷ In its analysis of the extent of public rights in Private Tidelands, the SJC commented that “[i]f a possessory interest in real property has any meaning at all it must include the general right to exclude others.”¹⁶⁸ The SJC built on its 1974 Opinion in a 1981 *Opinion of the Justices* (“1981 Opinion”). This 1981 Opinion noted that “[i]t appears, therefore, that the public interest in flats reclaimed pursuant to lawful authority may be extinguished, and, if deemed appropriate, the Legislature may act to declare that those rights have been extinguished so as to assure the marketability of title to such property.”¹⁶⁹ Thus, Massachusetts case law limits the public uses of Private Tidelands to those clearly related to fishing, fowling, and navigation.¹⁷⁰

Existing case law is less clear about potential limits of the private use of Private Tidelands to uses and activities related to navigation, fishing, and other forms of maritime commerce. The 1974 and 1981 Opinions neither identify additional limitations on the uses of Filled Tidelands nor discuss whether the uses located thereon must be specifically

¹⁶³ *Id.*

¹⁶⁴ *Id.*

¹⁶⁵ *Id.* (internal quotation marks omitted) (citing *Charlestown*, 18 Mass. (1 Pick.) at 183–84).

¹⁶⁶ *Id.* at 567.

¹⁶⁷ *Id.*

¹⁶⁸ *1974 Opinion*, 313 N.E.2d at 568.

¹⁶⁹ *Opinion of the Justices (1981 Opinion)*, 424 N.E.2d 1092, 1099 (Mass. 1981).

¹⁷⁰ *See 1981 Opinion*, 424 N.E.2d at 1099; *1974 Opinion*, 313 N.E.2d at 566.

navigation-related or water-dependent.¹⁷¹ To the contrary, in these two key opinions, the SJC noted that the Colonial Ordinance only limits private use within Private Tidelands to building on these tidal lands so as not to unreasonably interfere with navigation.¹⁷² However, in other historical and recent case law, the SJC at times has emphasized the policy behind the enactment of the Ordinance; namely, the need for private investment in structures, such as wharves and piers, to encourage the development of colonial maritime commerce.¹⁷³

B. *Massachusetts Public Waterfront Act of 1866 (Chapter 91)*

Today, Chapter 91 of the Massachusetts General Laws (“MGL”) provides the “principal tool” for the protection, management, and promotion of public use of tidelands and other waterways.¹⁷⁴ The Public Waterfront Act of 1866 (“Chapter 91” or the “Act”) creates the Commonwealth’s tidelands and waterways licensing program.¹⁷⁵ Originally

¹⁷¹ See *1981 Opinion*, 424 N.E.2d at 1099 (discussing that an owner could fill tidelands without discussing future uses); *1974 Opinion*, 313 N.E.2d at 568 (discussing the effects of a proposed bill on littoral property owners without discussing filled tidelands).

¹⁷² See *1981 Opinion*, 424 N.E.2d at 1099 (quoting *1974 Opinion*, 313 N.E.2d at 566 and citing to several cases from the mid-1800s and early 1900s) (“A so-called ‘littoral owner may build on his tidal land so as to exclude the public completely as long as he does not unreasonably interfere with navigation.’”).

¹⁷³ See *Bos. Waterfront Dev. Corp.*, 393 N.E.2d at 359–60 (“As to the land between high and low water marks, however, commonly referred to as the flats, the Massachusetts colonial law and practice deviated from the English law. Chief Justice Parsons explained this legal development very artfully in his opinion in *Storer v. Freeman*: ‘When our ancestors emigrated to this country, their first settlements were on harbors or arms of the sea; and commerce was among the earliest objects of their attention. For the purposes of commerce, wharves erected below high water mark were necessary. But the colony was not able to build them at the public expense. To induce persons to erect them, the common law of *England* was altered by an ordinance, providing that the proprietor of land adjoining on the sea or salt water, shall hold to low water mark, where the tide does not ebb more than one hundred rods, but not more where the tide ebbs to a greater distance.’” (citations omitted) (quoting *Storer v. Freeman*, 6 Mass. (6 Tyng.) 435, 437 (1810))); *Charlestown*, 18 Mass. (1 Pick.) at 183 (“The desire and necessity of wharves, quays or piers was soon felt by individuals and the community, and the occupation of flats became indispensable. The government then, to encourage these objects, and to prevent disputes and litigations, transferred its property in the shore of all creeks, coves, and other places upon the salt water, where the sea ebbs and flows, giving to the proprietor of the land adjoining the property of the soil to low-water mark, where the sea does not ebb above one hundred rods.”); see also *Trio Algarvio, Inc. v. Comm’r of the Dep’t of Env’tl. Prot.*, 795 N.E.2d 1148, 1151 (Mass. 2003) (citing *Bos. Waterfront Dev. Corp.*, 393 N.E.2d at 359–60, quoting *Storer*, 6 Mass. (6 Tyng.) at 437).

¹⁷⁴ MASS. GEN. LAWS ANN. ch. 91, § 1 (West 2012); MASS. DEP’T OF ENVTL. PROT., CHAPTER 91: THE MASSACHUSETTS PUBLIC WATERFRONT ACT 4 (2003), available at <http://www.mass.gov/dep/water/resources/c91comp.pdf>.

¹⁷⁵ MASS. DEP’T OF ENVTL. PROT., *supra* note 174.

enacted in 1866, the Act incorporated and built on the Colonial Ordinance.¹⁷⁶ The Act regulates activities on both coastal and inland waterways, including construction, dredging, and filling in of tidelands, certain rivers, and other waterbodies.¹⁷⁷

The Massachusetts Department of Environmental Protection (“MassDEP” or “the Department”) administers the Act.¹⁷⁸ Specifically, MassDEP has “charge of the lands, rights in lands, flats, shores and rights in tide waters belonging to the commonwealth.”¹⁷⁹ To protect the interests of the Commonwealth in these areas, the Department has responsibility for reviewing and issuing licenses for structures and uses in tidelands, including Private Tidelands, to ensure they are retained “for water-dependent uses or otherwise serve a proper public purpose.”¹⁸⁰ To this end, MassDEP has promulgated its Waterways Regulations to establish procedures, criteria, and standards for the uniform administration of provisions of Chapter 91.¹⁸¹

The Act defines “tidelands” generally as both “present and former submerged lands and tidal flats lying below the mean high water mark.”¹⁸² Further, it defines “Private Tidelands” as those “tidelands held by a private party subject to an easement of the public for the purposes of navigation and free fishing and fowling and of passing freely over and through the water.”¹⁸³ The Act also defines “Commonwealth Tidelands” as those “tidelands held by the commonwealth in trust for the benefit of the public or held by another party by license or grant of the commonwealth subject to an express or implied condition subsequent that it be used for a public purpose.”¹⁸⁴ The Act defines “Water-Dependent Uses” as “uses and facilities which require direct access to, or location in, marine or tidal waters,” and establishes the characteristics for a “substantial structural change” or “change in use,” requiring Chapter 91 review and licensing.¹⁸⁵

MassDEP’s Waterways Regulations elaborate and expand on the Act’s statutory definitions. For Private Tidelands, the Department pre-

¹⁷⁶ *Id.*

¹⁷⁷ *Id.* at 3, 5–6; *see* MASS. GEN. LAWS ANN. ch. 91, § 14 (providing authority for licensing of structures in, over, and under tide waters).

¹⁷⁸ MASS. DEP’T OF ENVTL. PROT., *supra* note 174, at 3.

¹⁷⁹ MASS. GEN. LAWS ANN. ch. 91, § 2.

¹⁸⁰ MASS. GEN. LAWS ANN. ch. 91, § 2 (West 2012).

¹⁸¹ *See* 310 MASS. CODE REGS. 9.00–.55 (2012).

¹⁸² MASS. GEN. LAWS ANN. ch. 91, § 1.

¹⁸³ *Id.*

¹⁸⁴ *Id.*

¹⁸⁵ *See id.*

sumes, “in accordance with the [Colonial Ordinance] . . . that tidelands are [P]rivate [T]idelands if they lie landward of the historic low water mark, or of a line running 100 rods (1650 feet) seaward of the historic high water mark, whichever is farther landward.”¹⁸⁶ For Commonwealth Tidelands—also referred to in Massachusetts case law as Submerged Lands¹⁸⁷—MassDEP “presume[s] that tidelands are Commonwealth [T]idelands if they lie seaward of the historic low water mark or of a line running 100 rods (1650 feet) seaward of the historic high water mark, whichever is farther landward.”¹⁸⁸ MassDEP’s regulations provide methods for determining the historic high and low water marks, and further distinguish between “Flowed Tidelands” and “Filled Tidelands”—both generally subject to MassDEP’s jurisdiction and licensing requirements under Chapter 91.¹⁸⁹ The former includes “present submerged lands and tidal flats which are subject to tidal action,” and the latter includes previously “submerged lands and tidal flats which are no longer subject to tidal action due to the presence of fill.”¹⁹⁰

The Waterways Regulations also define “Water-Dependent Use” as a use that “requires direct access to or location in tidal or inland waters, and therefore cannot be located away from said waters.”¹⁹¹ Regulations require that nonwater-dependent use projects that include fill or structures within any tidelands subject to Chapter 91 jurisdiction do not “unreasonably diminish the capacity of such lands to accommodate water-dependent use[s].”¹⁹² Such projects must not unreasonably interfere with nearby water-dependent uses and related facilities.¹⁹³ Under the Waterways Regulations, all licenses must state the term for which the license is effective.¹⁹⁴ Although the maximum standard fixed term of a Chapter 91 license is thirty years, MassDEP has discretion to issue an extended license with up to a sixty-five year term for projects within Flowed Tidelands and a ninety-nine year term for any projects on Filled Tidelands.¹⁹⁵ Upon its expiration, the license can be renewed for a second term of the same length.¹⁹⁶

¹⁸⁶ See 310 MASS. CODE REGS. 9.02.

¹⁸⁷ *E.g.*, *Arno*, 931 N.E.2d at 14; *1981 Opinion*, 424 N.E.2d at 1099.

¹⁸⁸ 310 MASS. CODE REGS. 9.02 (2012).

¹⁸⁹ *Id.* at 9.01–.02.

¹⁹⁰ *Id.* at 9.02.

¹⁹¹ See *id.* at 9.12(2).

¹⁹² *Id.* at 9.51.

¹⁹³ See *id.*

¹⁹⁴ 310 MASS. CODE REGS. 9.15(1) (2012).

¹⁹⁵ *Id.*

¹⁹⁶ *Id.* at 9.25(2).

Furthermore, MassDEP defines “Beach Nourishment” as “the placement of clean sediment . . . on a beach to increase its width and volume for purposes of storm damage prevention, flood control, or public recreation.”¹⁹⁷ It defines “Coastal or Shoreline Engineering Structure” as “any breakwater, bulkhead, groin, jetty, revetment, seawall, weir, riprap or any other structure which by its design alters wave, tidal, current, ice, or sediment transport processes in order to protect inland or upland structures from the effects of such processes.”¹⁹⁸ In its 2007 Beach Nourishment Guide, MassDEP identifies both beach nourishment and the utilization of dredged sediment for beach fill as Water-Dependent activities under Chapter 91 and its Waterways Regulations.¹⁹⁹ Although MassDEP encourages use of non-structural beach nourishment to help prevent storm damage and control flooding, it notes that site-specific conditions and proximity to sensitive resources, such as salt marshes and shellfish beds, must also be considered to minimize environmental impacts and maximize protection of existing development and infrastructure.²⁰⁰ Both the Act and regulations anticipate the need for soft and hard engineering to stabilize the shoreline from the effects of climate-change related sea level rise (“SLR”).²⁰¹

Finally, for new buildings located within a flood zone and intended for human occupancy for nonwater-dependent uses,²⁰² MassDEP’s Waterways Regulations presently require that such buildings be designed and constructed to withstand wind and wave forces associated with a one hundred-year storm and incorporate projected SLR during the life of the building.²⁰³ In light of the projected climate change-related increases in the frequency of today’s one hundred-year floods, conservatively anticipated to occur every two to three years in the Boston area,²⁰⁴ present flood-design construction standards will need to be significantly updated to account for more frequent and severe coastal flooding, particularly for projects with extended term Chapter 91 li-

¹⁹⁷ *Id.* at 9.02.

¹⁹⁸ *Id.*

¹⁹⁹ HANEY ET AL., *supra* note 121, at 8.

²⁰⁰ *Id.* at 6.

²⁰¹ *See* MASS. GEN. LAWS ANN. ch. 91, § 14 (West 2012) (discussing structures MassDEP may license, including uses that can be considered soft or hard engineering actions); 310 MASS. CODE REGS. 9.02 (2012) (defining various activities that can be considered soft or hard engineering actions).

²⁰² Nonwater-dependent uses include restaurants, retail stores, offices, residences, and hotels. 310 MASS. CODE REGS. 9.12(2).

²⁰³ *See id.* at 9.37(2)(b).

²⁰⁴ *See supra* note 61 and accompanying text.

censes.²⁰⁵ Further, the regulations only require new building designs to include SLR projections based on historical rates of increase in New England coastal areas.²⁰⁶ However, based on projections for significantly accelerated SLR for the twenty-first century, scientifically accepted projections, not historical rates, should be used as the SLR baseline for new construction design.

C. *Massachusetts Global Warming Solutions Act of 2008*

Signed into law in July 2008, the Massachusetts Global Warming Solutions Act (“GWSA”) represents “landmark climate legislation” adopted by the Massachusetts legislature.²⁰⁷ The GWSA, primarily codified in Massachusetts General Laws Chapter 21N, requires the Commonwealth to establish economy-wide greenhouse gas (“GHG”) emissions reduction goals: by 2020, the state must achieve a 10–25% reduction below 1990 baseline levels, and by 2050, the reduction must be 80% below the 1990 baseline.²⁰⁸ Notably, the GWSA requires the Secretary of the Executive Office of Energy and Environmental Affairs (“EEA”) to adopt a plan for achieving these reductions, determine whether compliance with the established emissions limit is feasible, and oversee implementation of climate change-related regulations.²⁰⁹ It allows the Secretary, in consultation with other state agencies, to consider the use of market mechanisms to address “climate change concerns.”²¹⁰ The Act requires the Secretary to convene an advisory committee to oversee statewide GHG reduction measures, and a separate advisory committee to “analyze strategies for adapting to the predicted impacts of climate change in the commonwealth.”²¹¹

In April 2010, the MassDEP issued a Draft Climate Implementation Plan to serve as a framework for meeting the required 2020 and 2050 emissions reduction goals of the GWSA.²¹² Thereafter, MassDEP held public hearings in June and received comments on its Draft Plan

²⁰⁵ See 310 MASS. CODE REGS. 9.15.

²⁰⁶ See *id.* at 9.37(2)(b)(2).

²⁰⁷ Kimmell & Burt, *supra* note 11, at 302.

²⁰⁸ MASS. GEN. LAWS ANN. ch. 21N, §§ 3–4 (West 2012); see *Overview of the Global Warming Solutions Act (GWSA)*, MASS. DEP’T. OF ENVTL. PROT., <http://www.mass.gov/dep/air/climate/gwsa.htm> (last visited May 7, 2013).

²⁰⁹ MASS. GEN. LAWS ANN. ch. 21N, §§ 4–5.

²¹⁰ *Id.* § 7.

²¹¹ *Id.* § 8; 2008 Mass. Legis. Serv. 583 (West).

²¹² MASS. DEP’T OF ENVTL. PROT., COMMONWEALTH OF MASSACHUSETTS: DRAFT CLIMATE IMPLEMENTATION PLAN I (2010), *available at* <http://www.mass.gov/dep/air/climate/draftcip.pdf>.

through July 2010.²¹³ This Draft Plan included the Commonwealth's strategies for meeting its statewide GHG reduction goals, and noted that the GWSA provides an avenue toward energy efficiency savings, energy independence, and new job creation.²¹⁴ In its final question to be considered at public hearings, MassDEP addressed the Draft Plan's linkage to adaptation planning.²¹⁵ In addition, MassDEP noted that some GHG emissions reduction strategies also function as strategies for adapting to the "climate change that is unavoidable," but did not expand on this statement or include any specific adaptation measures.²¹⁶

The final Massachusetts Clean Energy and Climate Plan for 2020 ("Climate Plan"), issued in December 2010, reviews climate change generally, its observed effects, and its potential impacts.²¹⁷ The Climate Plan states that "Massachusetts is vulnerable to severe impacts from climate change."²¹⁸ The Climate Plan identifies impacts to coastal natural resources including: "[s]ubstantial increases in the extent and frequency of coastal flooding and increased risk of severe storm-related damage," and "[p]ermanent inundation of low-lying coastal areas and increased shoreline erosion and wetland loss due to projected sea-level rise and increased wave action."²¹⁹ Despite addressing these issues, the Climate Plan's "Integrated Portfolio of Policies," its section on implementation, and its roadmap for "Policy Directions to be Developed in the Coming Years" do not explicitly address climate adaptation strategies.²²⁰

The majority of the GWSA's text and the EEA's related Climate Plan focus on GHG emissions reduction goals, plans, and potential implementation strategies.²²¹ As part of advisory committee input required by the GWSA, the EEA convened a Climate Change Adaptation Advisory Committee ("AAC") in May 2009 to review and recommend

²¹³ MASS. DEP'T OF ENVTL. PROT., PUBLIC COMMENT ON GLOBAL WARMING SOLUTIONS ACT IMPLEMENTATION, at i, 2 (2010), available at <http://www.mass.gov/dep/air/climate/gwsapc.pdf>.

²¹⁴ See MASS. DEP'T. OF ENVTL. PROT., *supra* note 212.

²¹⁵ *Id.* at 8.

²¹⁶ *Id.*

²¹⁷ See IAN A. BOWLES, EXEC. OFFICE OF ENERGY & ENVTL. AFFAIRS, MASSACHUSETTS CLEAN ENERGY AND CLIMATE PLAN FOR 2020, at 8–10 (2010).

²¹⁸ *Id.* at 10.

²¹⁹ *Id.*

²²⁰ See *id.* at 13–94, 104–06.

²²¹ See generally MASS. GEN. LAWS ANN. ch. 21N (West 2012) (outlining GHG regulations and implementation requirements); BOWLES, *supra* note 217 (discussing a variety of policies to reduce emission through improved energy efficiency).

climate change adaptation strategies.²²² The AAC held meetings and public information sessions in the summer of 2009 and presented an introduction to climate change science and the vulnerabilities of the coastal zone to climate change-related SLR to the Massachusetts legislature in October 2009.²²³ Following extended internal state-level review of its original draft recommendations, the EEA submitted the AAC's final report and recommendations, which include proposed adaptation strategies, to the Massachusetts legislature in September 2011.²²⁴

In consideration of the anticipated effects of climate change, the GWSA amended MGL Chapter 30, section 61, which codifies the Massachusetts Environmental Protection Act.²²⁵ The GWSA inserted language requiring that, “[i]n considering and issuing permits, licenses and other administrative approvals and decisions, the respective agency, department, board, commission or authority shall also consider *reasonably foreseeable climate change impacts*, including additional greenhouse gas emissions, and effects, such as *predicted sea level rise*.”²²⁶ Chapter 30 defines “Departments” broadly to include all of the Commonwealth’s departments and executive offices.²²⁷ Section 61 further requires a determination of environmental impacts and review of the use of “all practicable means and measures to minimize damage to the environment” by all state agencies and authorities.²²⁸ The statute also includes a presumption—unless a clear contrary intent is manifested—that “all statutes shall be interpreted and administered so as to minimize and prevent damage to the environment.”²²⁹ Thus, while not yet integrated specifically into current state regulations or policies, this section of the GWSA may provide state agencies with authority to consider the effects of climate change, including accelerated SLR, in their review of uses and activities within Public and Private Tidelands, adjacent coastal areas, and related

²²² *Climate Change Adaptation Advisory Committee*, MASS. DEP’T OF ENVTL. PROT., <http://www.mass.gov/dep/public/committee/ccaac.htm> (last visited May 7, 2013). MassDEP also contributed to this committee. *Id.*

²²³ CLIMATE CHANGE ADAPTATION ADVISORY COMM., OVERVIEW FOR THE MASSACHUSETTS LEGISLATURE ON CLIMATE CHANGE ADAPTATION (2009); *Climate Change Adaptation Advisory Committee*, *supra* note 222 (follow hyperlinks to presentations for additional information).

²²⁴ EEA & ADAPTATION ADVISORY COMM., *supra* note 13, at i; *see infra* notes 232–247 and accompanying text.

²²⁵ MASS. GEN. LAWS ch. 30, § 61 (2001 & Supp. 2012).

²²⁶ MASS. GEN. LAWS ch. 30, § 61 (Supp. 2012) (emphasis added).

²²⁷ *Id.* § 1. Note the definition of Departments herein expressly exempts the Massachusetts department of banking and insurance. *Id.*

²²⁸ *Id.* § 61.

²²⁹ *Id.*

license and permit conditions.²³⁰ However, such conditions, including those issued with Chapter 91 licenses, would likely lead to legal claims from coastal property owners, including those alleging unconstitutional takings by the Commonwealth of existing littoral property rights.²³¹

D. *Massachusetts Climate Change Adaptation Report of 2011*

In its 2011 Climate Change Adaptation Report (“the Adaptation Report”), the EEA found that “[c]limate change—with its resulting acceleration of sea level rise, potential increased frequency and intensity of storms, and shifts in ocean temperature, currents and chemistry—is altering these already dynamic environments, exacerbating coastal management challenges.”²³² In assessing the vulnerabilities of the Commonwealth’s coastal zone, the Adaptation Report observes that if “[u]naddressed, climate change will result in significant impacts to Massachusetts’ coast and ocean waters” and that “[i]mpacts could include loss of life; extensive property damage; destruction of public infrastructure; release of sewage, oil, debris, and other contaminants; and loss of commercial and marine-related businesses critical to local, regional, and state economies.”²³³ The Adaptation Report recommends potential adaptation strategies to address climate change-related vulnerabilities of commercial and residential developments, ports, and public infrastructure located within the Commonwealth’s coastal zone.²³⁴ These adaptation strategies include discouraging development projects in vulnerable areas, such as those subject to storm surges and wind-driven waves, high erosion rates, and flooding.²³⁵ The Adaptation Report also recommends accounting for the movement of coastal resource areas, such as salt marshes and dunes, and their capacity to respond to changing conditions.²³⁶ To mitigate the risk of repetitive losses from reoccurring storm damage to coastal properties, the EEA and AAC recommend commencing public discussion regarding how the Commonwealth should prioritize major public investments aimed at protecting existing development.²³⁷ The Adaptation Report observes that both public and private projects in large, populous, urban areas

²³⁰ *See id.*

²³¹ *See infra* notes 248–249 and accompany text.

²³² EEA & ADAPTATION ADVISORY COMM., *supra* note 13, at 108.

²³³ *Id.*

²³⁴ *Id.* at 108–13.

²³⁵ *Id.* at 110.

²³⁶ *Id.*

²³⁷ *Id.*

will likely prioritize highly engineered structural protection measures.²³⁸ Conversely, the Adaptation Report also notes that some coastal areas may be able to reduce risks by implementing less engineered measures, such as Low Impact Development.²³⁹

The EEA's Adaptation Report identifies regulatory and policy-based tools to help achieve its recommended adaptation strategies.²⁴⁰ The Adaptation Report encourages development of policy guidance to fully implement existing Chapter 91 regulations incorporating impacts of projected SLR "during the design life of buildings."²⁴¹ Further, the EEA and AAC recommend reviewing the Massachusetts Wetlands Protection Act's rules and policies to identify possible revisions to address predicted changes in the location of coastal wetlands and resource areas.²⁴² The Adaptation Report recommends reducing the number of vulnerable coastal properties via voluntary land acquisition, and potential adoption of a statewide "rolling easement" policy for existing shoreline development, coupled with policies that prevent coastal armoring.²⁴³

The Adaptation Report also recommends developing policies for new building design and construction in response to climate change.²⁴⁴ The EEA and AAC promote adopting the "No Adverse Impact" approach—currently included in the Massachusetts Office of Coastal Zone Management's StormSmart Coasts program—that recommends that construction projects avoid any adverse or cumulative impacts to nearby properties.²⁴⁵ In addition, the Adaptation Report recommends exploring the expansion of recent revisions to the State Building Code to increase requirements for storm-resistant building designs, materials,

²³⁸ EEA & ADAPTATION ADVISORY COMM., *supra* note 13, at 110.

²³⁹ *Id.* at 110–11. Low Impact Development prioritizes natural processes to reduce the harmful impacts of flooding and stormwater. *Id.* at 118.

²⁴⁰ *Id.* at 111–13.

²⁴¹ *Id.* at 112.

²⁴² MASS. GEN. LAWS ch. 131, § 40 (West 2012); EEA & ADAPTATION ADVISORY COMM., *supra* note 13, at 112.

²⁴³ EEA & ADAPTATION ADVISORY COMM., *supra* note 13, at 112. Coastal armoring generally refers to the use of hard structures such as dams or bulkheads to protect land and buildings from the effects of erosion and floods. TITUS, *supra* note 4, at 1.

²⁴⁴ EEA & ADAPTATION ADVISORY COMM., *supra* note 13, at 112.

²⁴⁵ *Id.* Under this approach, new development will not adversely impacting other properties by limiting "increased runoff, velocities, or degradation" in the surrounding area. Edward A. Thomas & Sam Riley Medlock, *Mitigating Misery: Land Use and Protection of Property Rights Before the Next Big Flood*, 9 VT. J. ENVTL. L. 155, 163 (2008).

and features.²⁴⁶ Further, regulators can account for projected rise in water table levels through revised septic system rules.²⁴⁷

IV. LEGAL CHALLENGES TO CLIMATE CHANGE ADAPTATION STRATEGIES

Private property owners in Massachusetts and other coastal states have and will likely continue to challenge the constitutionality of both state and local laws impacting coastal land use. Laws restricting coastal development, limiting or conditioning permitted land uses along coastlines, or requiring increased conservation of undeveloped lands to accommodate the landward migration of associated natural areas will likely encounter resistance from landowners. Impacting beaches, tidal flats, and coastal wetlands, laws attempting to address and mitigate the impacts of climate change—specifically sea level rise (“SLR”), coastal flooding, and increased coastal erosion—will necessarily impinge upon private property rights.²⁴⁸ The current takings jurisprudence of the U.S. Supreme Court and the Massachusetts Supreme Judicial Court (“SJC”) informs any application of the claims arising from increased coastal land use regulations imposed to increase social adaptation to the effects of climate change.²⁴⁹

A. *Takings of All Economically Beneficial Uses*

The Takings Clause of the Fifth Amendment of the U.S. Constitution provides that private property may not be taken for public use without just compensation.²⁵⁰ When determining the limited issue of whether *all* uses of a given parcel of property have been taken, courts follow the judicial precedent established by the Supreme Court in *Lucas v. South Carolina Coastal Council*.²⁵¹ Courts look to the “background principles” of state property law to determine if a governmental taking

²⁴⁶ EEA & ADAPTATION ADVISORY COMM., *supra* note 13, at 112.

²⁴⁷ *Id.*

²⁴⁸ *See, e.g.*, Thomas & Medlock, *supra* note 245, at 170–72 (discussing takings challenges in response to floodplain regulation); Titus, *supra* note 15, at 1388 (discussing SLR and legal challenges resulting from regulation).

²⁴⁹ *See Palazzolo v. Rhode Island*, 533 U.S. 606, 611 (2001) (discussing takings challenge in a wetland area); *Lucas v. S.C. Coastal Council*, 505 U.S. 1003, 1006–07 (1992) (determining if South Carolina’s Beachfront Management Act presented a taking).

²⁵⁰ U.S. CONST. amend. V. The Fifth Amendment applies to state action through the Fourteenth Amendment of the U.S. Constitution. U.S. CONST. amend. XIV, § 1. Massachusetts also has a similar takings provision in its state constitution which provides that “whenever the public exigencies require that the property of any individual should be appropriated to public uses, he shall receive a reasonable compensation therefor.” MASS. CONST. art. X.

²⁵¹ *E.g., Palazzolo*, 533 U.S. at 617; *see* 505 U.S. at 1029–30.

of private property has occurred.²⁵² In *Lucas*, the petitioner purchased two littoral lots on a barrier island where he intended to build residences.²⁵³ Two years later, the South Carolina legislature enacted the Beachfront Management Act, which established a new development setback from eroding coastal beaches.²⁵⁴ The law had the direct effect of barring Lucas from building permanent habitable structures on either of his coastal properties.²⁵⁵ The Supreme Court of South Carolina concluded that Lucas was not entitled to compensation under the Takings Clause of the Fifth Amendment because the legislature passed the Act “to prevent serious public harm.”²⁵⁶

The U.S. Supreme Court found that where state regulations “prohibit *all* economically beneficial use of land,” such limitations “cannot be newly legislated or decreed (without compensation), but *must inhere in the title itself*, in the restrictions that background principles of the State’s law of property and nuisance already place upon land ownership.”²⁵⁷ Further, the Court held that “a regulation that declares ‘off-limits’ all economically productive or beneficial uses of land goes beyond what the relevant background principles would dictate, [and] compensation must be paid to sustain it.”²⁵⁸ The Court remanded the case and emphasized that to win, the State had to do more than declare Lucas’s desired land use incompatible with the public interest or in violation of a common law principle.²⁵⁹ Instead, it needed to “identify background principles of nuisance and property law that prohibit the uses [Lucas] now intends in the circumstances in which the property is presently found.”²⁶⁰

Almost a decade later, the U.S. Supreme Court again addressed an asserted regulatory taking of *all* economically beneficial uses in *Palazzolo v. Rhode Island*.²⁶¹ The Court explained that to prove such a taking,

²⁵² *Lucas*, 505 U.S. at 1029.

²⁵³ S.C. CODE ANN. § 48-39-250 to -360 (2012); *Lucas*, 505 U.S. at 1006–07.

²⁵⁴ *Id.* at 1006–09.

²⁵⁵ *Id.* at 1007.

²⁵⁶ *Id.* at 1009–10 (quoting *Lucas v. S.C. Coastal Council*, 404 S.E.2d 895, 899 (S.C. 1991)).

²⁵⁷ *Id.* at 1029 (emphasis added). In footnote 16, in relation to the State’s power to abate nuisances that affect the public generally, “or otherwise,” the U.S. Supreme Court found that the principal “otherwise” indicated instances of “‘actual necessity, to prevent the spreading of a fire’ or to forestall other grave threats to the lives and property of others.” *Id.* at n.16 (citing *Bowditch v. Boston*, 101 U.S. 16, 18–19 (1880)).

²⁵⁸ *Lucas*, 505 U.S. at 1030.

²⁵⁹ *Id.* at 1031–32.

²⁶⁰ *Id.* at 1031.

²⁶¹ 533 U.S. at 606, 617.

a plaintiff must demonstrate that the challenged regulation leaves “the property ‘economically idle’” and that the landowner retains less than “a token interest.”²⁶² In *Palazzolo*, the petitioner owned a waterfront parcel, almost all of which was designated as coastal wetlands by state law when petitioner acquired title.²⁶³ When Rhode Island’s Coastal Resources Council rejected his development proposals, Palazzolo sued, claiming that the state’s wetlands regulations constituted a taking under the Fifth Amendment.²⁶⁴ The Supreme Court of Rhode Island rejected Palazzolo’s claim based on evidence of two hundred thousand dollars of remaining development value on an upland portion of the property, which contradicted his claimed deprivation of all beneficial use.²⁶⁵ Palazzolo had argued that the upland portion of his parcel was distinct from the wetlands portions.²⁶⁶ The Court, however, found that because Palazzolo initially alleged a taking of the entire parcel, the “total deprivation” of all economically beneficial uses argument failed.²⁶⁷

In 2010, the U.S. Supreme Court reviewed landowners’ challenges to state legislation affecting coastal land use in *Stop the Beach Renourishment, Inc. v. Florida Department of Environmental Protection*.²⁶⁸ The Court unanimously affirmed the challenged Florida Supreme Court’s decision upholding the Florida Beach and Shore Preservation Act and its implementation through state-approved beach renourishment projects, holding the law did not contravene the plaintiffs’ established property rights.²⁶⁹ The plaintiffs, who owned beachfront property bordering a beach renourishment project, argued Florida invalidated their common-law right to have their properties touch the water.²⁷⁰ The Court found that the State had not taken the plaintiffs’ private property—specifically, littoral rights to future accretion, reliction, and contact of littoral property with the water—without just compensation in violation of the Fifth and Fourteenth Amendments of the U.S. Constitution.²⁷¹ In upholding the Florida Supreme Court’s decision, the Court held

²⁶² *Id.* at 631 (citing *Lucas*, 505 U.S. at 1019).

²⁶³ *Id.* at 611, 626. Palazzolo’s property consisted of eighteen wetland acres and additional upland acres. *Id.* at 646 (Ginsburg, J., dissenting).

²⁶⁴ *Id.* at 611 (majority opinion).

²⁶⁵ *Palazzolo v. Rhode Island*, 746 A.2d 707, 714–17 (R.I. 2000).

²⁶⁶ *Palazzolo*, 533 U.S. at 631.

²⁶⁷ *Id.* at 631–32.

²⁶⁸ 130 S. Ct. 2592, 2600 (2010).

²⁶⁹ FLA. STAT. § 160 (2012); *Stop the Beach Renourishment, Inc. v. Fla. Dep’t of Envtl. Prot.*, 130 S. Ct. 2592, 2599, 2613 (2010).

²⁷⁰ *Stop the Beach Renourishment, Inc.*, 130 S. Ct. at 2600, 2610.

²⁷¹ *Id.* at 2612.

that the Act was consistent with the background principles of Florida's property law—specifically, its common law regarding the relative priority of private property owners' littoral rights vis-à-vis the State's existing rights to use its adjacent submerged lands and foreshore.²⁷²

Massachusetts's public trust doctrine differs from the public trust approach in Florida. In Florida, the State owns the land permanently submerged beneath navigable waters and the foreshore in trust for the public.²⁷³ In Massachusetts, however, the adjacent littoral property owners typically own Private Tidelands, pursuant to the Massachusetts Bay Colonial Ordinance of 1641–47 (“Colonial Ordinance”) and the Massachusetts Public Waterfront Act of 1866 (“Chapter 91”).²⁷⁴ Under the Colonial Ordinance, a littoral property owner's fee simple interest in these Private Tidelands has always been subject to an easement held by the Commonwealth for fishing, fowling, and navigation.²⁷⁵

Several centuries of state common law in Massachusetts have defined the extent of and specific uses associated with public and private rights to these legally muddy Private Tidelands.²⁷⁶ Notably, a key restriction in these tidal flats is that private uses cannot unreasonably interfere with the public's right of navigation so as to constitute a public nuisance.²⁷⁷ Further, under state common law, private fee simple ownership of submerged lands—those lying seaward of the historic mean low water line, also referred to as Commonwealth or Public Tidelands—is

²⁷² *Id.* at 2611–12; Fla. Dep't of Envtl Prot. v. Stop the Beach Renourishment, Inc., 998 So.2d 1102, 1120–28 (Fla. 2008).

²⁷³ *Stop the Beach Renourishment, Inc.*, 130 S. Ct. at 2597–98 (describing the land permanently submerged beneath navigable waters and the foreshore area as the land between the mean low tide and high water marks).

²⁷⁴ 310 MASS. CODE REGS. 9.02 (2012) (defining Private Tidelands); see *Commonwealth v. Charleston*, 18 Mass. (1 Pick.) 180, 182–83 (1822) (discussing that, prior to the Colonial Ordinance, under common law as originally imported to the American colonies from England, under a grant of a house lot adjacent to the sea, the littoral proprietor owned only to the high water mark, and the right of sovereign—passed from the Crown to the entities which later became the Commonwealth—ran seaward from the ordinary high water mark, inclusive of the “shore” which was “the space between [the] high-water and low-water mark” or flats).

²⁷⁵ See *Arno v. Commonwealth*, 931 N.E.2d 1, 13 (Mass. 2010). Specifically, the SJC stated that, in earlier case law, “we referred to the public's interest in tidal flats as an ‘easement of the public for the purposes of navigation and fishing and fowling, and of passing freely over and through the water without any use of the land underneath, wherever the tide ebbs and flows.’” *Id.* at 17 (citing *Butler v. Att'y Gen.*, 180 N.E. 688, 689 (Mass. 1907)).

²⁷⁶ See, e.g., *Opinion of the Justices (1981 Opinion)*, 424 N.E.2d 1092, 1099 (Mass. 1981); *Bos. Waterfront Dev. Corp. v. Commonwealth*, 393 N.E.2d 356, 359–61 (Mass. 1979); *Charlestown*, 18 Mass. (1 Pick.) at 183–84.

²⁷⁷ See *1981 Opinion*, 424 N.E.2d at 1099; *Bos. Waterfront Dev. Corp.*, 393 N.E.2d at 369; *Opinion of the Justices (1974 Opinion)*, 313 N.E.2d 561, 566 (Mass. 1974); *Charlestown*, 18 Mass. (1 Pick.) at 183–84.

subject to a “condition subsequent” that these tidelands be used for the specific public purpose for which they were granted to the landowner by the Massachusetts legislature.²⁷⁸

Considering the centuries-old use restrictions placed on a littoral property owner’s fee simple title of Private Tidelands, this easement in favor of public uses for navigation, fishing, and fowling would likely be considered under *Lucas* to inhere in the title itself, and relate to background principles of Massachusetts’s property and nuisance law.²⁷⁹ Thus, Massachusetts law could be interpreted expansively in its impacts on private land without implicating the Takings Clause.²⁸⁰ Laws and regulations related to the preservation or improvement of navigation and coastal resources in Private or Commonwealth Tidelands that provide critical habitat and breeding grounds for fish, birds, and other wildlife would support the activities protected by the public trust.²⁸¹ Even if such laws directly or indirectly deprived affected littoral owners of all economically beneficial uses in these areas or impaired their littoral property rights, they would likely not be considered takings.²⁸² Such

²⁷⁸ *Arno*, 931 N.E.2d at 17–18. As the SJC explained:

[O]ur use of the terms ‘easement’ and ‘fee simple subject to a condition subsequent’ should not, however, be interpreted as importing the manifold doctrines, limitations, and precedents that apply to those words in ordinary contexts where they are used to reflect bargains struck between or among private parties. Rather, in the case of tidelands, the terms serve, in essence, as placeholders for historic public rights present in the *jus publicum*.

Id. The SJC further explained that the term “easement” in the context of tidelands “represents the public rights in tidal flats reserved to the public by the Colonial Ordinance of 1641–1647.” *Id.* at 18.

²⁷⁹ See 505 U.S. at 1029.

²⁸⁰ See *id.*

²⁸¹ See Colonial Ordinance, *supra* note 147, §§ 2–4.

²⁸² See *Home for Aged Women v. Commonwealth*, 89 N.E. 124, 129 (Mass. 1909). In 1909, in *Home for Aged Women v. Commonwealth*, the SJC acknowledged that the State held Public Tidelands, located below then tidally-influenced low water mark of the Charles River Basin, “both as owner of the fee and as the repository of sovereign power.” *Id.* at 125. The Commonwealth made changes to promote safer and more convenient navigation, and generally improve public health and comfort. *Id.* at 126, 129. These changes also had the consequence of impairing the use of adjacent littoral properties, including direct access to the water. *Id.* at 126. The SJC found, however, that the Commonwealth’s changes did not constitute a taking. *Id.* at 129. About fifty years later, the court revisited its holding in *Home for Aged Women*. See *Michaelson v. Silver Beach Improvement Ass’n*, 173 N.E.2d 273, 276 (Mass. 1961). In *Michaelson v. Silver Beach Improvement Ass’n*, the Commonwealth had attempted to create a public beach by casting dredge materials along the shoreline of private littoral properties, thereby cutting off their exclusive access to the sea. *Id.* at 274. The SJC found that the Commonwealth’s power to control navigable tidal waters and tidelands “is not unlimited.” *Id.* at 276. Although its past cases, including *Home for Aged Women*, allowed the Commonwealth to exercise its specific powers to regulate and improve navigation and

reasoning would also apply to expanded resource buffers or future development setbacks seaward of the mean high water mark within the area subject to easement, and which members of the public can exercise their reserved use rights in Private Tidelands.²⁸³ Further, other use restrictions in tidelands, to allow for natural landward migration of coastal wetlands and other natural areas that support fish and wildlife, would also likely survive *Lucas's* per se takings analysis because of the background principles of the Commonwealth's established coastal property laws and public use doctrine.²⁸⁴

As most Private Tidelands are part of a larger parcel of littoral property that includes adjacent uplands, a court reviewing an alleged takings claim due to regulation of tideland areas would look to a petitioner's entire parcel to serve as the denominator for the takings claim.²⁸⁵ If regulations allowed for some economically beneficial use on upland portions of the littoral property—or more than a “token interest”—the claim would likely fail as a “total deprivation” under *Palazzolo*.²⁸⁶ If the state or affected municipalities wanted to avoid the creation of parcels existing solely of coastal wetlands or tidelands, they could enact subdivision control laws that prevent the creation of undevelopable coastal properties comprised solely of these protected natural resource areas. As noted in *Palazzolo* and by the U.S. Supreme Court in its takings jurisprudence, where landowner petitioners fail to establish a deprivation of *all* economically beneficial uses, these claims are examined under the Court's traditional analysis for regulatory takings established in the 1978 Supreme Court case *Penn Central Transportation Co. v. New York City*.²⁸⁷ In general, due to the background principles of state law inherent in littoral property rights and the typical combined composition of most littoral properties, the more flexible and regulation-

fisheries, the SJC had never found that the Commonwealth had the power to build beaches for bathing purposes without compensating the affected littoral owners. *Id.* at 277. In *Michaelson*, the SJC found that a Commonwealth project is immune from private property rights takings claims “only when it is so related to a project under the acknowledged public powers in the navigable waters (such as over navigation and the fisheries) that enjoyment of the latter project would be substantially impaired without the creation of the former.” *Id.*

²⁸³ See *Home for Aged Women*, 89 N.E. at 129.

²⁸⁴ See *Lucas*, 505 U.S. at 1029; *Home for Aged Women*, 89 N.E. at 129.

²⁸⁵ See *Palazzolo*, 533 U.S. at 616; *Public Rights Along the Shoreline*, MASS. OFFICE OF COASTAL ZONE MGMT., <http://www.mass.gov/czm/shorelinepublicaccess.htm> (last visited May 7, 2013).

²⁸⁶ See *Palazzolo*, 533 U.S. at 616, 631.

²⁸⁷ See *id.* at 617; *Penn Cent. Transp. Co. v. New York City*, 438 U.S. 104, 124 (1978); *infra* notes 292–295 and accompanying text.

friendly *Penn Central* analysis, rather than the strict per se *Lucas* regulatory takings test, will likely apply to most coastal property takings claims arising in Massachusetts.

B. Takings Under the *Penn Central* Balancing Test

One year after its *Palazzolo* decision, the U.S. Supreme Court reviewed and decided *Tahoe-Sierra Preservation Council, Inc. v. Tahoe Regional Planning Agency*, in which the petitioners raised a regulatory taking claim following development restrictions imposed by a regional planning agency.²⁸⁸ In *Tahoe-Sierra*, the Court observed that “[t]he categorical rule that we applied in *Lucas* states that compensation is required when a regulation deprives an owner of ‘all economically beneficial uses’ of his land.”²⁸⁹ The Court noted the *Lucas* test “was limited to the extraordinary circumstance when *no* productive or economically beneficial use of land is permitted. . . . Anything less than a complete elimination of value, or a total loss . . . would require the kind of [takings] analysis applied in *Penn Central*.”²⁹⁰ In *Lingle v. Chevron U.S.A. Inc.*, the Court further reaffirmed the use of *Penn Central* “as the principal guidelines for resolving regulatory takings claims that do not fall within the physical takings or *Lucas* rules.”²⁹¹

In *Penn Central*, the Court acknowledged that it had “been unable to develop any set formula for determining when justice and fairness require that economic injuries caused by public action be compensated by the government, rather than remain disproportionately concentrated on a few persons.”²⁹² Through its earlier ad hoc, factual inquiries, the Court had identified several factors of particular significance.²⁹³ Specifically, the Court considered: (1) “[t]he economic impact of the regulation on the claimant;” (2) “the extent to which the regulation has interfered with distinct investment-backed expectations;” and (3) “the

²⁸⁸ *Tahoe-Sierra Pres. Council, Inc. v. Tahoe Reg'l Planning Agency*, 535 U.S. 302, 306 (2002). In *Tahoe-Sierra*, the regional planning agency had imposed two moratoria, totaling thirty-two months, on development in the Lake Tahoe Basin while formulating a comprehensive land-use plan for the area. *Id.* Real estate owners, represented by an association, and individual owners, filed suits, later consolidated, which claimed the agency's actions constituted a taking of their property without just compensation. *See id.* at 312–13.

²⁸⁹ *Id.* at 330 (quoting *Lucas*, 505 U.S. at 1019).

²⁹⁰ *Id.* (citations omitted) (internal quotation marks omitted).

²⁹¹ *Lingle v. Chevron U.S.A. Inc.*, 544 U.S. 528, 539 (2005).

²⁹² 438 U.S. at 124 (internal quotation marks omitted).

²⁹³ *Id.*

character of the governmental action.”²⁹⁴ The *Penn Central* Court also noted that it will uphold land use regulations when a state tribunal could reasonably conclude that the public’s “health, safety, morals, or general welfare would be promoted by prohibiting particular contemplated uses of land,” even if the land use regulation “destroyed or adversely affected recognized real property interests.”²⁹⁵

Land use laws and regulations likely to be enacted by the Commonwealth implementing climate change adaptation strategies would create new restrictions on the allowed use of coastal properties beyond those already existing within the fairly limited scope of the easement for public uses related to navigation, fishing, or fowling.²⁹⁶ As the Court noted in *Penn Central*, a takings review turns on a case-specific factual inquiry wherein the reviewing court would assess the economic impact of the regulation at issue on the claimant’s specific investment-backed expectations.²⁹⁷

Such a review would look to the amount that the claimant paid for the coastal property, the land use and development allowed on the property at the time of purchase, and the claimant’s reasonable expectations regarding uses allowed by current or anticipated land use and zoning laws.²⁹⁸ Regulations requiring physical public access on and over the upland portion of littoral properties held in fee simple absolute would likely be considered a physical invasion, under the second prong of the *Penn Central* test regarding the character of government action.²⁹⁹ Such regulations would require general rights of public easement across private uplands to the coast, and would thus be considered a taking.³⁰⁰ In contrast, land use laws reasonably related to protecting the public’s health, safety, and welfare in the face of reasonably projected SLR, increased coastal flooding and heightened storm surges would likely survive a takings analysis under the *Penn Central* balancing test.³⁰¹

²⁹⁴ *Id.* In evaluating the character of the governmental action, the Court distinguished between physical invasions and where “interference arises from some public program adjusting the benefits and burdens of economic life to promote the common good.” *Id.*

²⁹⁵ *Id.* at 125 (internal quotation marks omitted); see *Lingle*, 544 U.S. at 540 (“[T]he *Penn Central* inquiry turns in large part, albeit not exclusively, upon the magnitude of a regulation’s economic impact and the degree to which it interferes with legitimate property interests.”).

²⁹⁶ See EEA & ADAPTATION ADVISORY COMM., *supra* note 13, at 3.

²⁹⁷ *Penn Cent. Transp. Co.*, 438 U.S. at 124.

²⁹⁸ See *id.*

²⁹⁹ See *id.*

³⁰⁰ See *id.*

³⁰¹ See *id.*; *supra* notes 240–247 and accompanying text.

Approaching SLR through a statewide rolling easement policy for existing development along the shoreline, as discussed below, may prove more problematic.³⁰² Such a program would require public access across and over formerly unencumbered and already developed private uplands, and include policies to prevent armoring of eroding coastlines, specifically those adjacent to existing development on uplands or Filled Tidelands.³⁰³ Any related takings claims will likely be reviewed under *Penn Central*; although some cases may fall under the stricter *Lucas* and *Palazzolo* takings tests applicable in specific instances for a given land parcel.³⁰⁴

In 2005, the Massachusetts SJC addressed coastal floodplains restrictions in *Gove v. Zoning Board of Appeals*.³⁰⁵ The SJC examined the application of a municipal zoning ordinance prohibiting new residential dwellings to be constructed within a designated flood zone district and applied the “highly deferential” *Penn Central* takings test.³⁰⁶ Further, the SJC looked to the U.S. Supreme Court’s *Lingle* decision, finding the test “[i]n practical effect . . . renders a zoning ordinance valid under the [] Constitution unless its application bears no ‘reasonable relation to the State’s legitimate purpose.’”³⁰⁷ The SJC found that the evidence clearly established a reasonable relationship between the municipal prohibition against residential development on the plaintiff’s undeveloped lot and legitimate state interests.³⁰⁸ In addition to evidence of the potential danger a house on this coastal property would pose to local rescue workers, the court considered other evidence, including expert testimony that a proposed house could be moved off its foundation by an especially severe storm, thus endangering or damaging surrounding structures and property.³⁰⁹

The SJC in *Gove* also addressed plaintiff’s assertion of a total regulatory taking under *Lucas* and *Palazzolo*.³¹⁰ Finding that the facts in *Gove* “are no more indicative of a total taking than those considered by the []

³⁰² See *infra* notes 353–394 and accompanying text.

³⁰³ See U.S. GLOBAL CHANGE RESEARCH PROGRAM, *supra* note 38, at 88; *infra* notes 353–356 and accompanying text.

³⁰⁴ See *Palazzolo*, 533 U.S. at 617 (noting that regulations denying all beneficial use implicate *Lucas* whereas regulatory limits implicate *Penn Central*).

³⁰⁵ 831 N.E.2d 865, 867 (Mass. 2005).

³⁰⁶ *Id.* at 868–69, 873; TOWN OF CHATHAM, Protective Bylaw § IV(A) (2012).

³⁰⁷ *Gove*, 831 N.E.2d at 870 (quoting *Exxon Corp. v. Governor of Md.*, 437 U.S. 117, 125 (1978)); see *Lingle*, 544 U.S. at 545.

³⁰⁸ *Id.* at 871.

³⁰⁹ *Id.* at 871 & n.13.

³¹⁰ *Id.* at 872–73; see *Palazzolo*, 533 U.S. at 630–31; *Lucas*, 505 U.S. at 1026–32.

Supreme Court in *Palazzolo*” and that Gove had “failed to prove the challenged regulation left her property ‘economically idle,’” the court quickly dismissed the plaintiff’s contention.³¹¹ The SJC then evaluated Gove’s claim under the *Penn Central* balancing test. Under the first prong—evaluating claimant’s distinct investment-backed expectations—the court found that Gove did not sufficiently demonstrate her own financial investment in the lot.³¹² The SJC emphasized “her inability to demonstrate that she ever had any *reasonable* expectation of selling that particular lot for residential development, or that she has suffered any substantial loss as a result of the regulations.”³¹³ Rounding out its *Penn Central* analysis, the SJC noted “that ‘the character of the governmental action’”—enacting and enforcing the zoning ordinance—was “the type of limited protection against harmful private land use that routinely has withstood allegations of regulatory takings.”³¹⁴ The SJC concluded that reasonable municipal action mitigating potential flood hazards, “at the very least when it does not involve a ‘total’ regulatory taking or a physical invasion, typically does not require compensation.”³¹⁵

C. Land Use Exactions Under Nollan-Dolan

Whereas the *Penn Central* test addresses regulatory takings, the validity of permit conditions fall under a different test.³¹⁶ The U.S. Supreme Court’s so-called “*Nollan-Dolan*” two-step “essential nexus” and “rough proportionality” test provides a blueprint for landowners challenging the validity of conditions or requirements of applicable state environmental and land use permits.³¹⁷ The test would apply to such varied instances as Chapter 91 licenses issued by Massachusetts Department of Environmental Protection (“MassDEP”) and local permits issued by cities and municipalities, including land use, zoning, or building permits.³¹⁸

³¹¹ *Gove*, 831 N.E.2d at 872.

³¹² *Id.* at 873, 874–75 (discussing that Gove inherited the property).

³¹³ *Id.* at 875 (quoting *Lingle*, 544 U.S. at 539).

³¹⁴ *Id.*

³¹⁵ *Id.* For a detailed review of the No Adverse Impact floodplain planning and management strategies for flood-prone communities and an analysis of related Fifth Amendment takings challenges, including the *Gove* case, see Thomas & Medlock, *supra* note 245, at 163–76.

³¹⁶ See *Penn Cent. Transp. Co.*, 438 U.S. at 124.

³¹⁷ See *Dolan v. City of Tigard*, 512 U.S. 374, 388–91 (1994); *Nollan v. Cal. Coastal Comm’n*, 483 U.S. 825, 825 (1987); Titus, *supra* note 15, at 1339–42.

³¹⁸ See Titus, *supra* note 15, at 1339–42.

In *Nollan v. California Coastal Commission*, landowners in California challenged the State's authority to create conditions for a permit for the plaintiffs' rebuilding of their coastal residence.³¹⁹ The California Coastal Commission had required that the owners dedicate a public access easement across their oceanfront property, due to its determination that the rebuilt home would block the public's visual and psychological access to public beaches from the adjacent public roadway.³²⁰ The U.S. Supreme Court held that for the permit condition not to constitute an illegal taking of private property by the state government without just compensation, there must be an "essential nexus" between its legitimate state interests and the ends advanced as the justification for a given permit condition.³²¹

The Court noted that if the Commission had attached to its permit a condition that protected the public's ability to see the beach, despite the rebuilding of a larger residence, such as a building height or width restriction or a fence prohibition, "so long as the Commission could have exercised its police power . . . to forbid construction of the house altogether, imposition of the condition would also be constitutional."³²² The Court also observed that a permit condition would be constitutional even if it required that the plaintiffs provide a viewing spot on their property for those who would otherwise not be able to see the ocean because of their new house.³²³ Nevertheless, the Court found that the *lack* of a nexus between the permit condition and the original purpose of the Commission's coastal "building restriction converts that purpose to something other than what it was. The purpose then becomes, quite simply, the obtaining of an easement to serve some valid governmental purpose, but without payment of compensation."³²⁴ In *Nollan*, the Court concluded that "[w]hatever may be the outer limits of 'legitimate state interests' in the takings and land-use context, this is not one of them."³²⁵ Further, the Court stated that the restriction would be "an out-and-out plan of extortion" unless it served the same purpose as prohibiting development.³²⁶

³¹⁹ 483 U.S. at 827.

³²⁰ *Id.* at 827, 835.

³²¹ *Id.* at 837.

³²² *Id.* at 836.

³²³ *Id.*

³²⁴ *Id.* at 837.

³²⁵ 483 U.S. at 837.

³²⁶ *Id.* (quoting *J.E.D. Assocs. v. Atkinson*, 432 A.2d 12, 14–15 (N.H. 1981)).

The Court did not identify the “outer limits” of legitimate state interests in the takings and land use context.³²⁷ Seven years later, in its decision in *Dolan v. City of Tigard*, the Supreme Court held that property use restrictions in a land use permit may constitute a taking if it is not reasonably necessary to effectuate a substantial government purpose.³²⁸ Further, the Court held that the Fifth Amendment requires “rough proportionality” between the nature and extent of a use restriction or requirement and the impact of proposed development.³²⁹ In *Dolan*, the City conditioned its approval of a permit to expand a commercial building on the owner’s granting an easement on a portion of the property for a public greenway and the construction of a pedestrian pathway within an adjoining floodplain.³³⁰ The Court found that, although reducing flooding and traffic congestion were legitimate public purposes, the City’s exactions far surpassed the need for flood mitigation.³³¹ Further, and also unrelated to its interests of flood control, the Court viewed the dedication of land for a public greenway across private property as extremely problematic because the public access requirement struck at the core of the landowner’s property rights.³³² Specifically, the Court identified a landowner’s right to exclude others as “one of the most essential sticks in the bundle of rights that are commonly characterized as property.”³³³

The Court observed that the dedication of sidewalks and other public ways generally provided a reasonable means to avoid traffic congestion.³³⁴ Despite this, the majority in *Dolan* found that the City had not met its burden of showing that the vehicle trips generated from the proposed commercial building expansion reasonably related to its requirement of the dedication of a public pathway across the applicant owner’s property.³³⁵ Finally, although the Court noted as “laudable” the City’s goals of reducing flooding and vehicle congestion while providing public greenways, it noted that “there are outer limits to how this may be done.”³³⁶ Concluding its decision in a cautionary fashion, the Court stated that “[a] strong public desire to improve the public con-

³²⁷ *See id.*

³²⁸ 512 U.S. at 388 (citing *Penn Central*, 438 U.S. at 127).

³²⁹ *Id.* at 391.

³³⁰ *Id.* at 380.

³³¹ *Id.* at 396.

³³² *Id.* at 384.

³³³ *Id.* at 384, 393 (quoting *Kaiser Aetna v. United States*, 444 U.S. 164, 176 (1979)).

³³⁴ *Dolan*, 512 U.S. at 395.

³³⁵ *Id.*

³³⁶ *Id.* at 396.

dition [will not] warrant achieving the desire by a shorter cut than the constitutional way of paying for the change.”³³⁷

The Court’s *Nollan* decision affects any property use limitations or affirmative requirements included in permits issued by the Commonwealth, its cities, or municipalities.³³⁸ To satisfy the requirements of the Fifth and Fourteenth Amendments, the permits must have a clear link or “essential nexus” with the state’s legitimate interests—such as public protections against the reasonably anticipated effects of climate change along the state’s coastline, increased coastal flooding, and storm-related shoreline erosion.³³⁹ The substantial established body of scientific studies, observations, and related predictions of the global, and more localized effects of climate change will likely only serve to strengthen the legitimacy of the state’s interests.³⁴⁰ Thus, this legitimacy can establish the required legal nexus under *Nollan* for related waterfront and land use restrictions or requirements attached to permits for future development, redevelopment, or expansion of existing land use activities and uses of coastal properties.³⁴¹ Whether the second part of the Court’s regulatory takings test, developed in *Dolan*, is also adequately met, will remain a much tougher question.³⁴² Specifically, the state may have difficulty demonstrating the “rough proportionality” and reason-

³³⁷ *Id.* (quoting *Pa. Coal Co. v. Mahon*, 260 U.S. 393, 416 (1922)) (alteration in original). In a strong dissent in *Dolan*, Justices John Paul Stevens, Harry Blackmun, and Ruth Bader Ginsburg made the following argument:

In our changing world one thing is certain: uncertainty will characterize predictions about the impact of new urban developments on the risks of floods, earthquakes, traffic congestion, or environmental harms. When there is doubt concerning the magnitude of those impacts, the public interest in averting them must outweigh the private interest of the commercial entrepreneur. If the government can demonstrate that the conditions it has imposed in a land use permit are rational, impartial and conducive to fulfilling the aims of a valid land use plan, a strong presumption of validity should attach to those conditions. The burden of demonstrating that those conditions have unreasonably impaired the economic value of the proposed improvement belongs squarely on the shoulders of the party challenging the state action’s constitutionality. That allocation of burdens has served us well in the past. The Court has stumbled badly today by reversing it.

Id. at 411 (Stevens, J. dissenting).

³³⁸ *See* 483 U.S. at 834.

³³⁹ *See id.* at 837; EEA & ADAPTATION ADVISORY COMM., *supra* note 13, at 108.

³⁴⁰ *See* INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *supra* note 3, at 2; Byrne, *supra* note 18, at 625–26.

³⁴¹ *See Nollan*, 483 U.S. at 834; INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *supra* note 3.

³⁴² *See* 512 U.S. at 391.

able relation required between the nature and extent of a given coastal property use restriction or requirement and the anticipated impact of the proposed development or property use.³⁴³

Some adaptation strategies currently proposed by the Commonwealth to address the impacts of climate change on development and land use along Massachusetts's coastline will likely meet *Dolan's* requirements.³⁴⁴ Such adaptation strategies include: revising the State Building Code by strengthening requirements for storm-resistant building construction; enhancing separate septic system rules that account for projected rise in water table levels; and increasing local planning review to ensure that the design and construction of coastal development projects do not have adverse impacts on surrounding properties.³⁴⁵ Such actions appear to have the direct relationship needed and be proportionately related to the effects of climate change, including SLR.³⁴⁶

For other more overarching actions the government's burden will be much more substantial. For instance, it may be difficult to show a reasonable relationship and rough proportionality between a requirement for a landowner to maintain hard stabilization structures or implement recommended soft stabilization techniques near eroding shorelines or floodplains.³⁴⁷ Particularly, the uncertainty in the speed and extent of predicted climate change-related accelerated SLR, increased coastal flooding, and shoreline erosion provide the greatest obstacle to demonstrating the necessary relationship.³⁴⁸

Massachusetts's existing public trust doctrine and its legal protection of use-specific public activities—such as those related to traditional fishing, fowling, and navigation—may allow a court to uphold permits requiring shoreline structures or land management practices within existing Commonwealth and Private Tidelands.³⁴⁹ In contrast, permit conditions affecting adjacent private uplands to protect currently upland areas for the future migration of tidelands, coastal natural resources, and associated public uses will be considerably more difficult for state or local governments to argue persuasively for in court. As private landowners may challenge sudden shifts in the location of private

³⁴³ See *id.*; Titus, *supra* note 15, at 1346.

³⁴⁴ See 512 U.S. at 391; EEA & ADAPTATION ADVISORY COMM., *supra* note 13, at 110–13.

³⁴⁵ See EEA & ADAPTATION ADVISORY COMM., *supra* note 13, at 110–13.

³⁴⁶ See *Dolan*, 512 U.S. at 391.

³⁴⁷ See *id.*; *supra* notes 113–126 and accompanying text.

³⁴⁸ See INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *supra* note 3, at 2 & n.1.

³⁴⁹ See *Bos. Waterfront Dev. Corp.*, 393 N.E.2d at 360–61; 310 MASS. CODE REGS. 9.02 (2012).

and public property boundaries, courts could potentially extend the doctrine of avulsion to littoral properties.³⁵⁰

Finally, the right of private property owners to exclude others could provide an obstacle for the application of Massachusetts's public trust doctrine to coastal areas affected by climate change. Recognized by the highest state and federal courts as one of the defining and core features of private property, the strong legal precedent establishing the property owner's right to exclude physical access by the general public runs against any conditions imposed on that land.³⁵¹ Thus, any permits requiring public access on or across private uplands located adjacent to the coastline, exacted with the goal of accommodating future public use rights along the coastline in anticipation of accelerated SLR, will likely prove difficult for the government to defend in the context of the regulatory takings precedent in *Dolan*.³⁵²

D. Takings by Physical Invasion via Statewide "Rolling Easements"

One adaptation strategy recommended by the Massachusetts Executive Office of Energy and Environmental Affairs ("EEA") and its Climate Change Adaptation Advisory Committee ("AAC") in its final Adaptation Report addresses rolling easements.³⁵³ Under such a scheme, unburdened private uplands become subject to public use easements as sea levels rise.³⁵⁴ As noted in the report, "[t]hese rolling easements are typically coupled with policies that prevent armoring of the coast."³⁵⁵ Governmental agencies and academics have proposed and analyzed the legal viability of rolling easements as one of several options to ensure that human development and activities do not impede the natural inland migration of shorelines and coastal resource areas.³⁵⁶

³⁵⁰ See *infra* notes 382–386 and accompanying text.

³⁵¹ See, e.g., *Kaiser Aetna*, 444 U.S. at 176; *Arno*, 931 N.E.2d at 13; *Severance v. Patterson (Severance I)*, 370 S.W.3d 705, 709 (Tex. 2012).

³⁵² See 512 U.S. at 388–91.

³⁵³ EEA & ADAPTATION ADVISORY COMM., *supra* note 13, at 112.

³⁵⁴ U.S. GLOBAL CHANGE RESEARCH PROGRAM, *supra* note 38, at 88; see EEA & ADAPTATION ADVISORY COMM., *supra* note 13, at 112.

³⁵⁵ EEA & ADAPTATION ADVISORY COMM., *supra* note 13, at 112.

³⁵⁶ See Titus, *supra* note 15, at 1308–09, 1308 n.117, 1309 n.119. Titus cites to reports, including by the U.S. EPA Office of Policy and Planning, dating back to the late 1980s, that provide an overview of approaches to preserve wetland shorelines in response to rising sea levels, including the creation of rolling easements. *Id.* at 1308 n.117. Over twenty years ago, Robert Fischman reviewed policy options for protecting wetlands susceptible to migration. Robert L. Fischman, *Global Warming and Property Interests: Preserving Coastal Wetlands as Sea Levels Rise*, 19 HOFSTRA L. REV. 565, 570–74 (1991). More recently, J. Peter

Notably, Massachusetts's existing property law and public trust doctrine differs from many other U.S. states, including Florida and Texas.³⁵⁷ Namely, the Commonwealth only owns “submerged lands”—seaward of the historic mean low water mark, instead of the mean high water mark.³⁵⁸ Thus in Massachusetts, unlike many other coastal U.S. states, the property line between state and private ownership of tidelands is not an ambulatory boundary associated with the mean high water mark, but has already been demarcated and fixed at the historic low water mark by the Colonial Ordinance and Chapter 91.³⁵⁹

Under its public trust doctrine, the Commonwealth has and continues to reserve an easement for specific public uses above the historic mean low water mark.³⁶⁰ Within undeveloped Flowed Tidelands, these public use rights and the public trust easement would clearly move landward when reliction or gradual shoreline erosion occurs, tracking the ambulatory mean high water line.³⁶¹ Yet it is much less clear if this

Byrne discussed rolling easements in the context of *Severance v. Patterson*, discussed below. Byrne, *supra* note 18, at 630–31, *infra* notes 375–379 and accompanying text.

³⁵⁷ Titus, *supra* note 15, at 1367 fig.11.

³⁵⁸ 310 MASS. CODE REGS. 9.02 (2012); Titus, *supra* note 15, at 1366.

³⁵⁹ See 310 MASS. CODE REGS. 9.02; Tim Eichenberg, et al., *Climate Change and the Public Trust Doctrine: Using an Ancient Doctrine to Adapt to Rising Sea Levels in San Francisco Bay*, 3 GOLDEN GATE U. ENVTL. L.J. 243, 263 (2010); Titus, *supra* note 15, at 1364–69. The federal Submerged Lands Act provides that states hold title to navigable waters, tidelands to mean high tide, and submerged lands to three miles offshore. 43 U.S.C. § 1311 (2006). Massachusetts is among five states—including Maine, Pennsylvania, Delaware, and Virginia—that has granted rights of private ownership to the mean low water mark. Eichenberg, et al., *supra*. For an illustrative map of varying public common law interests in tidelands and shores of coastal U.S. states, see Titus, *supra* note 15, at 1367.

³⁶⁰ Colonial Ordinance, *supra* note 147, §§ 2–4; see 310 MASS. CODE REGS. 9.02. In *Arno v. Commonwealth*, the SJC commented that its use of “easement” was simply a “placeholder[] for historic public rights present in the jus publicum,” and does not “import[] the manifold doctrines, limitations, and precedents that apply to those words in ordinary contexts where they are used to reflect bargains struck between or among private parties.” 931 N.E.2d at 17–18.

³⁶¹ The public trust easement would also move seaward when accretion occurs, as affected landowners have the right to apportion the newly created uplands. See, e.g., *Lorusso v. Acapesket Improvement Ass'n*, 564 N.E.2d 360, 367 (Mass. 1990) (framing the “legal analysis by setting forth some well-established relevant principles having to do with the rights of littoral landowners. One of these is that, when the boundary between the water and the land changes by the gradual deposit of sand and clay and the like, then the line of ownership ordinarily follows the changing water line”) (internal citation omitted); *Michaelson*, 173 N.E.2d at 275 (“If the beach had been created by accretion, which occurs [w]hen the line between water and land bordering thereon is changed by the gradual deposit of alluvial soil upon the margin of the water the answer would be clear; for [i]t is settled that where accretions are made to land along the seashore the line of ownership follows the changing water line.”) (internal quotation marks omitted); *Allen v. Wood*, 152 N.E. 617, 620 (Mass. 1926) (finding “[a]ccretions to land bounding on a river or the sea belong to

public trust easement would roll landward in the case of Filled Tidelands that have already been developed by private landowners within the scope of their existing property rights and the conditions of Chapter 91 licenses.³⁶² Further, it is also unclear if the easement would move if the present locations of coastlines and mean high water lines shift dramatically and abruptly landward because of climate-change related SLR, increased coastal flooding, or accelerated storm-related erosion.³⁶³ Massachusetts case law does not typically distinguish between natural and man-made causes in determining whether a change in the mean high water mark affects a corresponding movement in the ambulatory line between Private Tidelands and adjacent private uplands.³⁶⁴ However, it is legally debatable whether rapid and sudden coastline changes caused by climate change should be judicially reviewed under

the owners of the adjoining land” and that “[i]t is well established, in the case of accretions to land along the seashore, that ‘the line of ownership follows the changing water line’” (quoting *E. Bos. Co. v. Commonwealth*, 89 N.E. 236, 238 (Mass. 1909)); *Phillips v. Rhodes*, 48 Mass. (7 Met.) 322, 325 (Mass. 1843) (holding that defendant’s private easement to gather seaweed on the beach below a specific field existed “[w]herever the beach exists in front of or below the field, there the right of taking the sea dressing extends, and it matters not whether the sea has gained upon the land or has receded. The beach remains, and to that the easement is appurtenant”); *Adams v. Frothingham*, 3 Mass. (3 Tyng.) 352, 362–63 (Mass. 1807) (holding that increases to the flats are annexed to the adjoining upland, to the distance of one hundred rods from the shore, and benefit of the landowner, but specifically finding that, “[t]his increase is of necessity gradual and imperceptible. No man can fix a period when it began, no testimony can mark the exact margin of the channel on any given day or year. . . . [F]urther, we think this an instance in which we may safely apply the maxim, *De minimis non curat lex* [the law does not concern itself with trifles]”); *Bergh v. Hines*, 692 N.E.2d 980, 982 (Mass. App. Ct. 1998) (finding “well-settled authority for the proposition that littoral (shoreline) boundaries are not fixed, because natural processes of accretion or erosion change them, and that easements, stated to run with such a boundary, ordinarily will follow the naturally changing line”) (internal citation omitted).

³⁶² See *Arno*, 931 N.E.2d at 12–13; *1981 Opinion*, 424 N.E.2d at 1103; 310 MASS. CODE REGS. 9.15 (providing that permits for Filled Tidelands may be granted by the MassDEP for a term of up to ninety-nine years).

³⁶³ See *Bergh*, 692 N.E.2d at 982 (discussing the “well-settled authority” that littoral boundaries changes as a result of natural and gradual processes); Sax, *supra* note 10, at 343.

³⁶⁴ See *Lorusso*, 654 N.E.2d at 367; *Michaelson*, 173 N.E.2d at 275; *Adams*, 3 Mass. (3 Tyng.) at 362. It can be argued that accelerated SLR caused by climate change is man-made instead of natural—but under existing Massachusetts case law, this distinction is not typically material as both natural forces and man-made activities may cause legally recognized *gradual* shifts in ambulatory coastal boundaries—so long as the property owner did not specifically create a change that benefits the land. See *Lorusso*, 654 N.E.2d at 367; *Michaelson*, 173 N.E.2d at 275.

the legal doctrines of accretion and reliction,³⁶⁵ or the doctrine of avulsion.³⁶⁶

A recent law review article by noted legal scholar and professor Joseph Sax concluded, after an extensive review of the ancient history of the legal doctrines of accretion and avulsion, that “[a]ny effort to characterize today’s rising sea levels as avulsive or accretive is empty of meaning.”³⁶⁷ The article proposes that title to littoral properties should “follow a moving water boundary without regard to the rate, perceptibility, or suddenness of the movement,” subject to only a handful of exceptions.³⁶⁸ Another legal scholar has recently argued that in the case of new legislative programs aimed at adapting to rising sea levels related to climate change, courts should not need to incorporate dated common law rules, which were developed under very different circumstances.³⁶⁹ Thus, the author argues “that the replacement of a common law rule with a statutory one . . . should have no bearing on whether a regulatory taking has occurred.”³⁷⁰

In line with these academic proposals, Texas enacted legislation that can allow for rolling public beachfront easements. The law, however, has also faced legal challenges to the legislation.³⁷¹ Texas courts had previously interpreted the Open Beaches Act to allow easements to shift with changes in coastline.³⁷² Private landowners in Texas challenged the enforcement of such policies, raising constitutional claims in *Severance v. Patterson*.³⁷³ The U.S. Court of Appeals for the Fifth Circuit heard the case, but certified questions for the Texas Supreme Court to resolve regarding its own property law.³⁷⁴

³⁶⁵ See *supra* notes 7–8 and accompanying text. Under Massachusetts case law, these doctrines are premised on the occurrence of gradual and imperceptible shifts in ambulatory or moving location of riparian and coastal shorelines. See *Michaelson*, 173 N.E.2d at 278.

³⁶⁶ Sax, *supra* note 10, at 306–07; see Donna R. Christie, *Of Beaches, Boundaries and SOB's*, 25 J. LAND USE & ENVTL. L. 19, 26–27 (2009). Under the doctrine of avulsion, ambulatory property lines do not shift after either natural or man-induced events that cause sudden and perceptible changes. See *supra* note 9 and accompanying text.

³⁶⁷ Sax, *supra* note 10, at 355–56.

³⁶⁸ *Id.* at 353. Sax’s exceptions include when a river shifts to a new channel, when a movement is caused by the owner, and when the movement is transient. *Id.* at 353–54.

³⁶⁹ See Byrne, *supra* note 18, at 638.

³⁷⁰ *Id.* at 639.

³⁷¹ See Open Beaches Act, TEX. NAT. RES. CODE ANN. § 61.011(a) (West 2011); *Severance v. Patterson (Severance II)*, 566 F.3d 790, 493 (5th Cir. 2009).

³⁷² *Severance II*, 566 F.3d at 493.

³⁷³ *Id.* at 566 F.3d at 492.

³⁷⁴ See *id.* at 503–04 (holding that plaintiff’s takings claim was not ripe, but certifying questions of state law to the Texas Supreme Court regarding whether Texas recognizes a

In 2012, the Texas Supreme Court completed an extensive legal analysis of the law surrounding changing coastlines at the request of the Fifth Circuit.³⁷⁵ In *Severance v. Patterson*, the Texas court reviewed its state property law on the application of the accretion and reliction versus avulsion doctrines to determine whether Texas's public beachfront easement—enforced by the state under the Texas Open Beaches Act—“rolls” landward onto formerly dry land, requiring private owners to permit public access.³⁷⁶ Although several Justices dissented, the majority of the Texas Supreme Court held that, as a matter of first impression, an avulsive event that suddenly moves the mean high tide line does not immediately deprive the landowner of the right to exclude others from the newly created beach.³⁷⁷ The court found that when sudden changes occur and materially alter the existing littoral boundaries, the private land and the attached easement is lost to the public trust.³⁷⁸ Importantly, the Texas Supreme Court based its analysis in *Severance I* in that state's own unique body of coastal property law.³⁷⁹

Similar cases that may arise under Massachusetts law should apply the general common law distinction between the doctrines of accretion and avulsion in determining whether ambulatory property boundaries and associated property rights should shift—in the case of accretion—or remain the same to comport with the law, as it has presently evolved, and its meaning as shaped by centuries of applicable case law in the case of avulsion. Such cases would decide whether the public easement

“rolling” public beachfront access easement). The court also certified a question of the extent to which a landowner would be entitled to compensation under Texas law or the U.S. Constitution for limitation on use of property effected by the landward migration of a rolling easement to guide the federal court's determination of plaintiff's Fourth Amendment unreasonable seizure claim. *Id.* The case went to the Texas Supreme Court in 2012. *Severance I*, 370 S.W.3d at 705. The court held that, as a matter of first impression, “if an avulsive event moves the mean high tide line and vegetation line suddenly and perceptibly, causing the former dry beach to become part of State-owned wet beach or completely submerged, the adjacent private property owner is not automatically deprived of her right to exclude the public from the new dry beach.” *Id.* at 723–24.

³⁷⁵ *Severance I*, 370 S.W.3d at 707–08.

³⁷⁶ Open Beaches Act, TEX. NAT. RES. CODE ANN. § 61.011(a) (West 2011); *Severance I*, 370 S.W.3d at 724–25.

³⁷⁷ *Severance I*, 370 S.W.3d at 723–24 (“If an avulsive event moves the mean high tide line and vegetation line suddenly and perceptibly, causing the former dry beach to become part of State-owned wet beach or completely submerged, the adjacent private property owner is not automatically deprived of her right to exclude the public from the new dry beach.”).

³⁷⁸ *Id.* at 724.

³⁷⁹ *Id.* at 708; see *Severance II*, 566 F.3d at 493.

can roll landward onto formerly unencumbered private uplands.³⁸⁰ In Massachusetts, littoral landowners' rights related to accretion and reliction are well-defined under existing state law, which is rich in meaning and legal application.³⁸¹ To date, however, the SJC has only had the opportunity to recognize the common law principle of avulsion in its historical review of riparian property boundaries.³⁸² Specifically, in 1826, the SJC examined the issue of a non-tidally influenced river where parties disputed the location of riparian property boundaries.³⁸³ In *Ingraham v. Wilkinson*, the SJC found:

The doctrine of alluvion and its consequences seems to be very clearly settled. That which is formed by gradual accretion, belongs to the owner of the soil to which it adheres. The land which may be separated from a man's farm by a sudden change of the bed of the river may be reclaimed by him who lost it.³⁸⁴

Climate change and associated SLR could offer an opportunity to revisit *Ingraham*. The increasing occurrence of events that precipitate sudden, violent, and perceptible changes in the Massachusetts coastline could cause an increase in related disputes regarding the relocation of littoral property interests and corresponding public use easements. It would appear very timely for the SJC to extend its historical recognition of avulsion beyond the context of riparian property boundaries to resolve related issues regarding the location of ambulatory littoral boundaries that demarcate public trust and private property interests.

In Massachusetts, state and local legislative updates can and should be democratically enacted to proactively address the emerging public policy imperative for social adaptation to the effects of climate change. Yet the Commonwealth's extensive body of coastal property law—including its case law reviewing the location and extent of the easement for public trust rights, state statutes, and local zoning bylaws—is by no means currently empty or void of continued meaning.³⁸⁵ To the con-

³⁸⁰ See Byrne, *supra* note 18, at 631; Christie, *supra* note 366, at 47–48.

³⁸¹ See *supra* note 361 and accompanying text.

³⁸² See *Ingraham v. Wilkinson*, 21 Mass. (4 Pick.) 268, 273 (1826).

³⁸³ *Id.* at 269–70. The SJC defined the appropriate boundary as the *filum aquae* or middle of the river. *Id.* at 273 & n.2.

³⁸⁴ *Id.* at 273. The term “alluvion” means “the wash or flow of water against the shore.” MERRIAM-WEBSTER'S COLLEGIATE DICTIONARY, *supra* note 7, at 31.

³⁸⁵ See, e.g., MASS. GEN. LAWS §§ 29A, 30A (2010) (describing protections for private property along the shore); 310 MASS. CODE REGS. 9.34 (2012) (discussing state and mu-

trary, Massachusetts's existing property law remains of great significance in any judicial determination of whether a claimed unconstitutional taking by the government of private coastal property has occurred by implementation of currently recommended climate change adaptation policies.³⁸⁶ State property law may be especially useful for any proposals seeking to enact a statewide rolling easements policy.³⁸⁷ Existing laws should strongly influence the careful judicial balancing of competing factors under the *Penn Central* takings test, particularly in regard to the economic impact of a regulation on a specific landowner's reasonable investment-backed expectations of the activities allowed on their coastal property.³⁸⁸ Such laws should inform cases where significant private investments were made based on existing state laws and regulations. A court should look to whether the state acted within the scope of its specific powers related to navigation and fishing under the public trust doctrine or effected a physical invasion of private property.³⁸⁹ Existing state property law should also direct any judicial determinations that a governmental taking of *all* economically beneficial uses of a specific coastal property has occurred under the *Lucas* and *Palazzolo* takings tests.³⁹⁰ Given the significant, continued value and desirability of coastal lands to a variety of users, it is very likely that affected parties will raise legal challenges to these changes, and Massachusetts's property law serves a means of resolving disputes among property owners.

Judicial review of the reasonableness of specific private investments in coastal properties can and should shift over time, depending in large part on the relative timing of enactments of legislation and related regulations for new coastal land uses and development.³⁹¹ The increasingly broad social and political acknowledgement of climate change should also influence the determination of reasonableness. Particularly impor-

municipal zoning laws); *Arno*, 931 N.E.2d at 13–14 (discussing Massachusetts's highly developed case law regarding tidelands).

³⁸⁶ See *Stop the Beach Renourishment, Inc.*, 130 S. Ct. at 2612.

³⁸⁷ See *Severance I*, 370 S.W.3d at 715 (using Texas property law to determine whether rolling easements can be recognized under state law).

³⁸⁸ See *supra* notes 288–315 and accompanying text.

³⁸⁹ See *Lingle*, 544 U.S. at 537; *Gove*, 831 N.E.2d at 871; *Bos. Waterfront Dev. Corp.*, 393 N.E.2d at 360.

³⁹⁰ See *supra* notes 250–267 and accompanying text.

³⁹¹ See *Stop the Beach Renourishment, Inc.*, 130 S. Ct. at 2611–12 (discussing the importance of established state property law at the time a conflict begins).

tant factors include the foreseeable effects on the Massachusetts coastline and related natural resource areas.³⁹²

In the absence of new state statutes to the contrary, the common law distinction should be used as an equitable tool. In determining between gradual accretion and reliction versus abrupt avulsion—and their respective effects of shifting the location of public uses and associated access protected by the public trust doctrine—a court can determine which background property rights, conditions, and limitations affected landowners could have anticipated when investing in coastal property. Such an evaluation would differ from situations where unanticipated and sudden changes, including those caused by climate change, occur.

National and international scientific consensus on global warming and climate change has clearly solidified over the last decade.³⁹³ Further, social acknowledgement of this consensus by a majority of the Commonwealth's citizens, as symbolized by the enactment of the Massachusetts Global Warming Solutions Act of 2008, has only just occurred within the last few years.³⁹⁴ Thus, the reasonableness of specific littoral landowners' expectations in the use of affected coastal properties should be reviewed and judged accordingly.

CONCLUSION: GENERAL INSIGHTS FOR ADAPTATION EFFORTS IN OTHER COASTAL REGIONS

In the United States, state and local governments will face many challenges in their development and implementation of successful and legally defensible laws, regulations, and land use strategies related to climate change. Any actions in a state like Massachusetts that can effectively and efficiently address the growing public policy imperative for proactive adaptation planning presented by the anticipated effects of climate change must address accelerated sea level rise, increased coastal flooding, and shoreline erosion. In addition, the Commonwealth's public trust doctrine and the U.S. Supreme Court's federal takings jurisprudence both necessarily inform any actions Massachusetts may take.

Some strategies proposed by the Commonwealth's Executive Office of Energy and Environmental Affairs for climate change adaptation in coastal areas would probably survive judicial scrutiny, if implemented and challenged. In contrast, others, specifically those that require the public's physical access to traditionally private properties, may not.

³⁹² See EEA & ADAPTATION ADVISORY COMM., *supra* note 13, at 108.

³⁹³ See *id.* at 12; INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *supra* note 3.

³⁹⁴ See EEA & ADAPTATION ADVISORY COMM., *supra* note 13, at 8, 23.

Most of the state's existing coastal property law and legal doctrines likely will prove inadequate over the course of the current century for resolving public versus private property ownership and use disputes. As unprecedented changes and shifts in local coastlines associated with and primarily caused by climate change occur, the current jurisprudence will prove ineffective.

Thus, as part of a public policy imperative, Massachusetts must adopt additional forward-looking state legislation, incorporating the reasonably anticipated effects of climate change on its regulation of traditional public and private property boundaries. Corresponding city and municipal ordinances and bylaws will also be needed to address these changes. These governmental actions must carefully navigate the constitutional limitations on the government's taking of private property without just compensation and equitably balance existing public and private interests in the state's environmentally and economically valuable coastal properties. Such balancing of these often competing interests will certainly not be easy, but must occur. Individual landowners and the general public will soon begin to directly experience and confront the many challenges presented by the effects of climate change, thus impacting traditionally accepted property boundaries and associated public and private uses and rights.

